ELECTRICAL REVIEW

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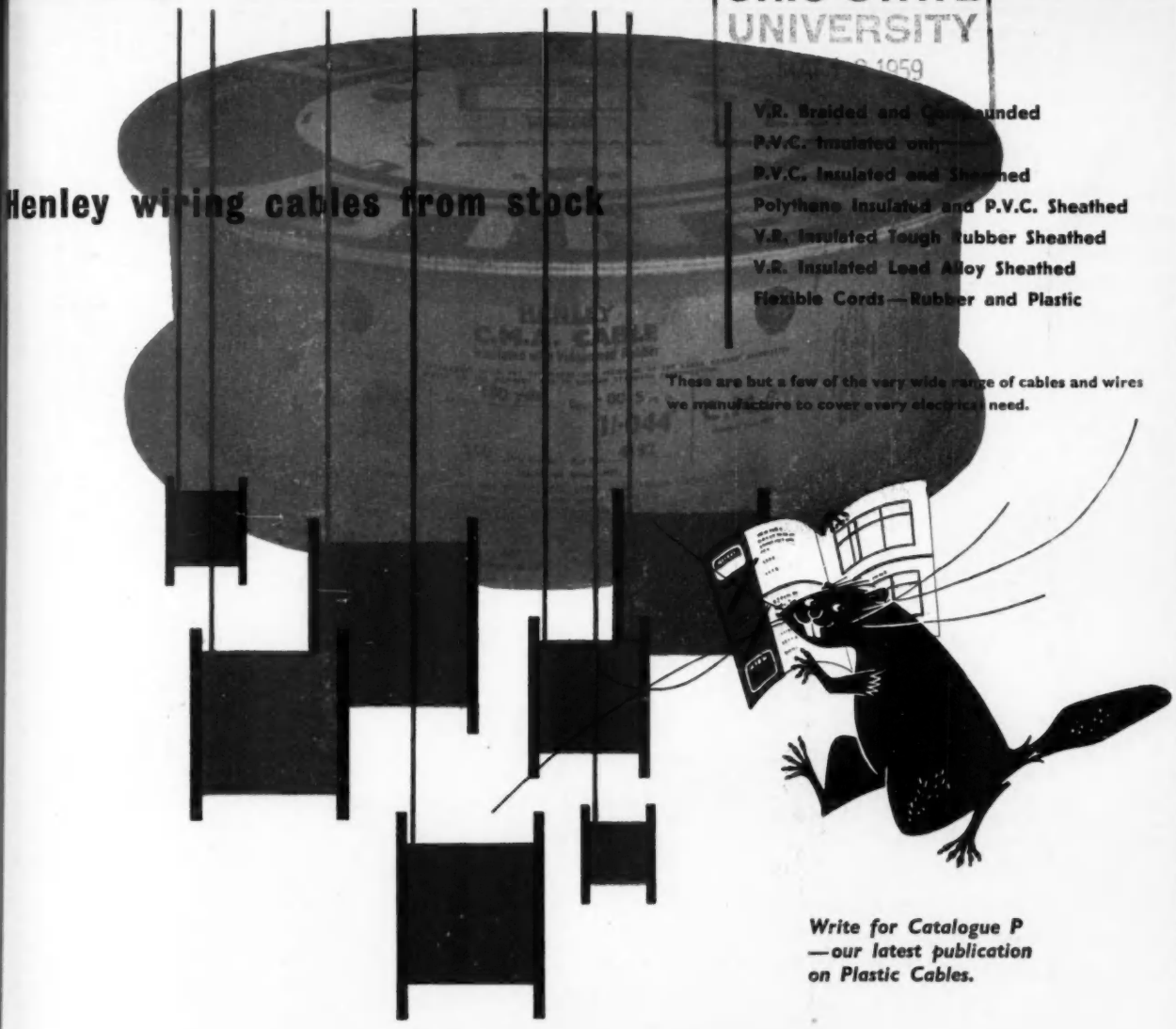
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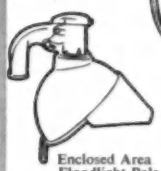

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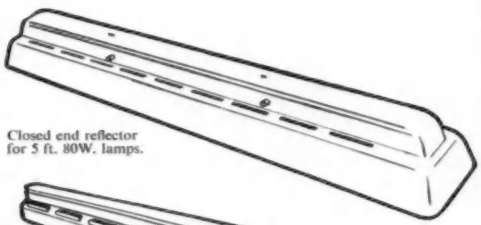

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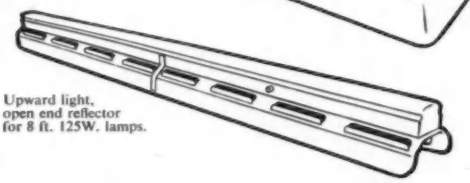

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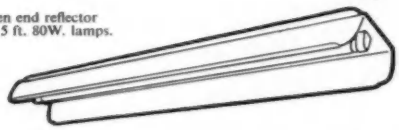

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ELECTRICAL REVIEW

24 April 1959 Vol. 164 No. 17 Established 1872

Testing Plant in Service

WORKS tests of engineering apparatus need to be supplemented by performance in commercial operation and this applies with particular force to the electricity supply industry in which 25 years or so of reliable service may be expected. Although working conditions can often be simulated in laboratories and the effects of ageing of new materials, perhaps introduced from sources outside normal engineering industry, can be expedited by special techniques, there remain many disturbing influences that come to light only after extended periods of time.

The two outstanding factors that increasingly affect the position—higher temperatures and higher voltages—have brought with them a number of problems. Steam temperatures more than twice that separating absolute zero (Kelvin) from atmospheric conditions are now standard practice, and it is rather expansion and contraction under changing electrical loads that create the most formidable difficulties; in these the heat compatibility of individual components is all-important. An illustration is provided by the starting and shutting down of large reheat generating units under two-shift operation so as to allow nuclear power stations to carry system base loads.

Differential expansion and contraction of the conductors and dielectrics of high-voltage cables during commercial load cycles, with consequent ionisation of voids, have been responsible for serious troubles in the past. Although these have for many years been surmounted, the setting up of a testing station at Staythorpe (Yorks), where cables for 275 kV can be operated in circuit with the grid, does more than offer opportunities to demonstrate ability to stand up to the hazards (including vagaries of manifestations of nature) involved in their connection to overhead systems.

The complex technological and practical problems associated with the trend towards ever higher transmission voltages are evident from discussions at C.I.G.R.E. as well as at the Institution of Electrical Engineers and will no doubt be illustrated in the decision to construct certain sections of the supergrid for possible later conversion to 480 kV when load conditions make this step desirable. For this purpose the British grid and supergrid have the essential two-fold aspect of highly localised concentrations of power generation and of relatively long transmission distances between points of production and use. It may well be that in days to come the knowledge gained through prolonged operational trials will come to be regarded as important as the economies the grid system is bringing now.

TRACTION VOLTAGES

Last week's official opening of the first 50 c/s commercial service on the Colchester-Clacton line illustrates the fact that, contrary to the general impression, two supply voltages are to be employed under the future a.c. electrification schemes. Besides 25 kV, a lower voltage of 6·25 kV will be used in urban areas where it would be uneconomic to raise bridges, tunnels, etc., to provide sufficient insulation clearance. Voltage sensing and switching equipment has to be installed on all trains and special arrangements have had to be provided at voltage change points on the overhead system so that through trains can be operated. The adoption of an a.c. traction system has also meant that the existing overhead telecommunication lines have had to be replaced by cables.

It is, however, comforting to note that Sir Reginald Wilson, chairman of the Eastern Area Board of the British Transport Commission, says that the new a.c. system is more economical than the 1,500 V d.c. electrification of the Chelmsford and Southend lines.

DEVELOPMENTS IN BRAKING

In many industrial applications it is necessary to employ some form of braking in connection with electric motor drives. This is frequently performed electrically and the methods most commonly used are "plugging" and d.c. injection. In the case of plugging the supply connections are reversed to produce a counter-torque whereas the other method involves passing a direct current through the motor winding. These methods are commonly used either because of the simplicity of control or the ease with which accurate braking characteristics can be calculated. However, both methods have a number of disadvantages.

A recently developed method of dynamically braking a.c. motors is described in this issue by Mr. S. A. Choudhury. This makes simultaneous use of capacitors and d.c. injection and is applicable to standard 50 to 60 c/s machines. It offers very favourable characteristics in such applications as machine tool drives where accurate positioning is necessary. For instance, if with a 5 h.p. 3-phase 1,500 r.p.m. motor d.c. injection braking is employed it will stop in 13 sec. If three capacitors were used it would take 27 sec to stop. By means of the author's system, which involves two capacitors and d.c. injection, the machine can be stopped in 1¼ sec.

REVIVAL IN NEW ZEALAND

After seventeen years of inadequacy of electricity supply in New Zealand, that Dominion's Minister of Electricity was able to announce recently that the industry was at last free from restrictions. Nevertheless he also said that "continued restraint will be most helpful." *Live Lines*, the journal of the Electrical Supply Authorities' Association of New Zealand, wryly asks what the distinction is between "restrictions" and "restraint," and suggests that the industry is not yet quite out of the wood. There is a difference, of course. Restriction seems to us to imply compulsion whereas restraint may be voluntary. Some hope for the future is based on the provision of a cable across Cook Strait to enable the power-starved North Island to obtain supplies from the better-placed South Island.

One effect of the long-continued restrictions is that the consumers are "conditioned" to excessive economy in the use of electricity and need re-education electrically. This is discussed by *Live Lines*, which envisages something like "the highly successful campaign conducted by Britain's E.D.A." Actually a number of leading N.Z. electricity supply authorities are overseas contributors to E.D.A. who would no doubt help in the electrical "rehabilitation" of the Dominion.

This resurgence should have an ultimate impact upon our own electrical manufacturing industry if import restrictions do not prevent it.

VOLTA RIVER DELAY

It has been announced from Accra that, following the receipt of a favourable report from the Henry J. Kaiser company (United States), the Government of Ghana has decided to award a contract to that concern for preliminary work on the projected Volta River hydro-electric scheme. Apparently the contract is not really an actual commencement of the scheme. The work which it covers is largely exploratory and is being undertaken to save time if and when it is decided to go ahead with the development.

As we have stated before, the financing of the scheme is proving difficult. It is closely linked with plans for the development of an aluminium industry, but the aluminium producers appear to be reluctant to put up the money. The Ghana Government has asked the United States Government to continue its endeavours to interest American aluminium companies and other possible large power users in the project. Whatever happens eventually it appears that at present reliance is being placed on the United States, although the original White Paper published in 1952 visualised the scheme as a partnership between the Gold Coast Government, the United Kingdom Government, Aluminum, Ltd., of Canada, and the British Aluminium Co.

NUCLEAR STATION COSTS

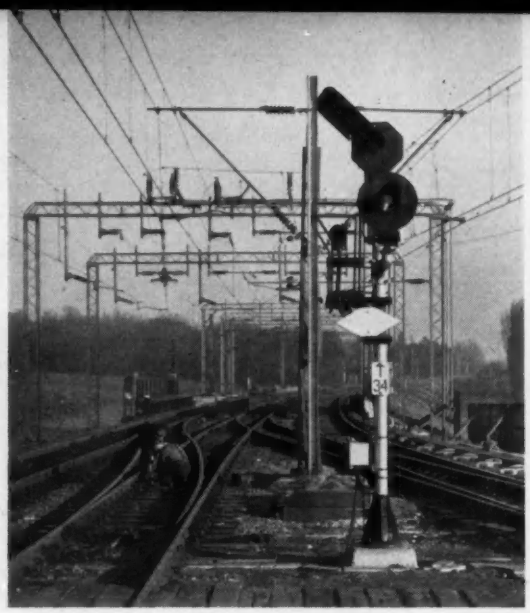
The exact prices quoted by the consortia for the nuclear power stations now being erected have not been disclosed; all that we have had is a very round figure for each. This is understandable, for the consortia are dealing with the unknown and cannot possibly have given very close quotations. We would have hoped, however, that the contracts would have been flexible enough to guard the groups against serious losses.

Yet Lord Chandos, whose company is largely responsible for the Berkeley station, said at the annual meeting of the A.E.I. last week that the company would incur substantial losses on the contract although they would not be of a size to affect markedly the net trading profit. Lord Chandos philosophically said that the knowledge and experience gained was likely to prove of great value in the future. Nevertheless, we feel that there is something inequitable in leaving the pioneers of nuclear power development to bear all the losses—if that is the intention.

The Colchester-Clacton line is now serving as a proving ground for equipment to be used in all future electrification at 25 and 6.25 kV 50 c/s. The multiple-unit rolling stock is fed via transformers with sectionalised primary windings which can be connected in series or parallel depending on the line voltage. In addition, some re-signalling has been carried out

OPENING OF FIRST 50 c/s

COMMERCIAL SERVICE



A.C. Railway Electrification

As mentioned in our last issue, the first 25 kV, 50 c/s electrification under the British Railways modernisation scheme was officially opened for commercial service last week. The line, which is between Colchester and Clacton and the branch serving Frinton-on-Sea and Walton-on-the-Naze, will serve as a proving ground for equipment to be used in all future electrification. At a luncheon following the opening, Sir Reginald Wilson, chairman of the Eastern Area Board of the British Transport Commission, said that the a.c. system was more economical than the 1,500 V d.c. electrification of the Chelmsford and Southend lines. After praising the work of the engineering department of the Region and the various contractors, he described future electrification plans of the Eastern Region. The lines to Enfield, Chingford, Hertford and Bishop's Stortford would be completed next year. The Chelmsford and Southend lines would be converted to a.c., the "gap" between Chelmsford and Colchester would be closed and, with the conversion of the rest of the East Anglian system to diesel traction, the whole of the Great Eastern would be entirely free of steam traction by the early 1960's.

Rolling Stock

The electrical equipment has been designed to the overall requirements of Mr. S. B. Warder, chief electrical engineer, British Railways Central Staff, British Transport Commission. Although the electrification of the new section is mainly at 25 kV, a small portion is energised at 6·25 kV for test purposes, as the line to Shenfield will be converted from d.c. to 6·25 kV a.c. The rolling stock in service on the Colchester-Clacton-Walton line is of the same design as that to be used on the London-Tilbury-Southend line. In all, 112 four-car sets will have been supplied by early 1960. The design for rolling stock for the Hertford-Bishop's Stortford lines will be generally similar.

With a full complement of passengers, a four-car set will weigh 153 tons and the maximum speed will be 75 m.p.h. All the electrical equipment is being supplied by the English Electric Co., Ltd.

The normal unit consists of four coaches—a battery driving trailer, a motor coach, a non-driving trailer and a driving trailer. The unit can be reduced to three coaches by omitting the non-driving trailer. Up to three units may be connected to operate in multiple unit.

Each motor coach is driven by four axle-mounted traction motors, each rated at 272 h.p., 620 V, 350 A, one hour, and driving through single reduction spur gearing. They have four poles and tapped field connections. The motor coach is supplied with 50 c/s single-phase supply at either 25 kV or 6·25 kV through a single roof-mounted pantograph of Stone-Faiveley manufacture and a Brown Boveri air-blast circuit-breaker. The supply is taken to a supply change-over switch and then to the transformer primary winding. The secondary winding of the transformer supplies four excitron type air-cooled mercury arc rectifiers which feed the traction motors.

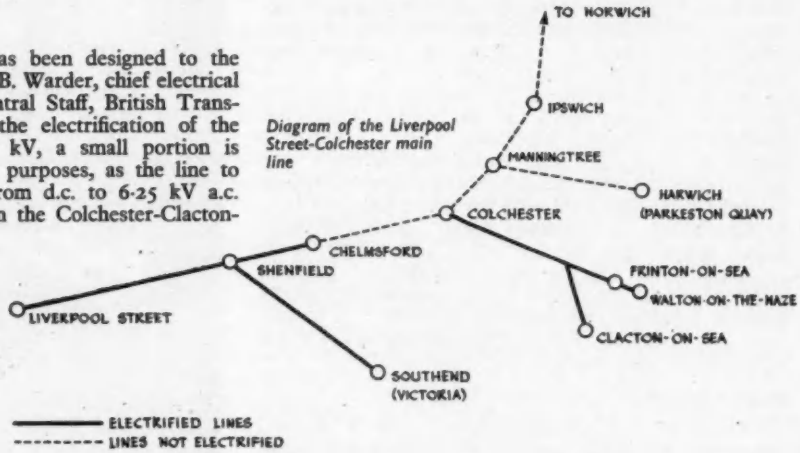


Diagram of the Liverpool Street-Colchester main line

Electric rolling stock at Alresford station

A tertiary winding provides a low-voltage supply for auxiliaries.

The transformer and reactors are mounted under the underframe and are oil cooled. Various cases mounted under the underframes of the coaches accommodate control equipment and auxiliary apparatus and heating and lighting equipment.

The line voltage detector unit senses whether the supply is 25 kV or 6·25 kV and appropriate connections of the transformer primary winding are made through voltage sensitive relays fed from a capacitive potential divider. The primary winding of the main transformer is arranged in four equal sections which are connected either in series or in parallel according to the supply voltage. The connections are made by a change-over switch mounted on the transformer tank.

The secondary winding consists of two equal sections connected so as to give a centre-tapped symmetrical winding. Each section has an equal number of tappings, so enabling the voltage supplied to the traction motors to be varied. The tertiary winding supplies auxiliaries such as compressor, radiator fan motor, oil circulating pump, rectifier cooling fans, battery charger and heating circuits.

Two rectifier cases are mounted on the motor coach underframe. Each contains two excitron type steel tank mercury arc rectifiers and their associated control equipment together with a 1·5 h.p., 240 V single-phase capacitor start-and-run type fan motor.

The master controller is of conventional type, but shallow in depth to match the cab layout. Five notch positions are provided (including "off") as well as the usual "deadman" and interlocking features. The battery mounted on the battery driving trailer underframe is of the nickel-cadmium type having 72 cells and is of 80 Ah capacity. It normally "floats" across a Westinghouse charger but supplies lights and auxiliaries as necessary. The charger is a transductor regulated rectifier with the d.c. output voltage maintained virtually constant by means of a magnetic controller. A bridge-connected system of metal rectifiers provides a 110 V d.c. supply for the main compressor.

Power Supply

The 25 kV, 50 c/s single-phase supply is obtained from two 7·5 MVA, 132/25 kV single-phase transformers at the Central Electricity Generating Board's Colchester substation. This supply is transmitted to the Colchester feeder station, a quarter of a mile from Colchester passenger station, via two 0·25 sq in concentric single-phase cables. At the feeder station the two cables are connected to two 300 MVA oil circuit-breakers which form part of a three-section 15-panel single-phase switchboard. The track feeder circuit-breakers supply the Colchester-Clacton line and will eventually supply the main Colchester-Ipswich line.

A temporary supervisory control station has been provided near the Colchester feeder station. From this control station, the circuit-breakers in the feeder station and track sectioning cabins are remotely controlled, together with eight power operated switches which have been installed at various points on the overhead equipment structures. The control equipment employs a system of coded voice frequency signalling. A new control room will be built when the Ipswich line has been electrified.

Overhead Equipment

Simple catenary construction is employed using a 19/·083in stranded cadmium copper catenary and a 0·166 sq in single cadmium copper contact wire attached to the catenary by droppers. Most of the overhead system is of the weight-tensioned type, constant tension being automatically applied by balance weights. At all terminal stations where running speeds are low, fixed termination simple catenary equipment has been installed.

The structures supporting the overhead line equipment are mainly of three types: B.F.B. (broad flange beam) section, fabricated lattice and fabricated welded rod. On open route sections of the double-line track, the great majority of structures consist of separate B.F.B. masts acting as single-track cantilevers for each track. With weight-tensioned equipment, the structure spacing is up to a maximum of 240ft, this spacing being reduced to a maximum of 210ft where fixed termination equip-

Rectifier equipment being assembled at the Stafford works of the English Electric Co. Two rectifiers are shown on either side of the fan compartment

ment is used. All overhead line equipment structures are galvanised.

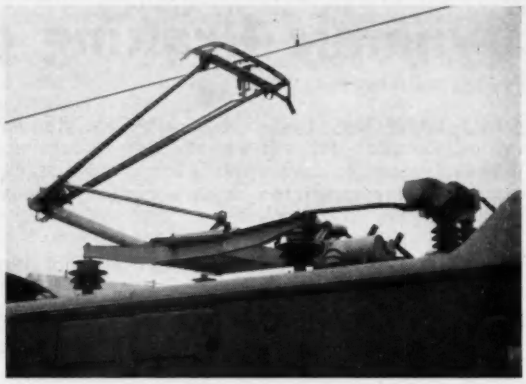
Overlap spans and neutral sections have been provided at convenient points along the line, which is thus sectioned electrically, not only at the feeder station and track sectioning cabins, but also by switches at certain strategically placed overlap spans. The a.c. feeder cables from the feeder station have been laid in concrete troughing at surface level.

Signalling

The Colchester-Clacton line and the branch to St. Botolphs have been re-signalled with colour light searchlight type signals and continuous track circuiting has been installed. The track circuits are of the d.c. single-rail type and none exceeds about 500 yd long. Power supplies for all signalling are taken from two local sources at 650 V, 50 c/s, single-phase. In the event of failure of either of these supplies, automatically operated contactors change over to a standby supply derived from the 25 kV traction system.

The aerial line route has been abolished and all circuits, both signalling and telecommunications, are carried in cables. The signalling cable is of the multi-core rubber-insulated and rubber-sheathed type and the telecommunications cables are air-spaced, paper-insulated conductors having an aluminium sheath with two p.v.c. sheaths on the outside.

There was little heavy civil engineering work involved in the electrification, but 22 bridges had to be raised or altered and at certain stations the track layout had to be revised. The main contractor for the electrification work was the British Insulated Callender's Construction Co., Ltd. Isolating switches were supplied by the Hackbridge & Hewittic Electric Co., Ltd. Traction equipment is being provided by the English Electric Co., Ltd. The high-voltage switchgear in the feeder station was supplied by Fuller Electric, Ltd., and the h.v. cables by Pirelli-General Cable Works, Ltd., and W. T. Henley's Telegraph Works Co., Ltd. Signalling work was carried out by the Siemens & General Electric Railway Signal Co., Ltd., and selective calling signal post telephone equipment was supplied by Standard Telephones & Cables, Ltd.



Pantograph on the new electric rolling stock

EXTENSION OF TECHNICAL EDUCATION

Three-Year Programme Costing £54 Million

A NEW capital investment programme planned to cost £54 million for technical education in the three years after 1961 was announced last week by Mr. Geoffrey Lloyd, Minister of Education. In a circular to local education authorities Mr. Lloyd says that in order to maintain the momentum of the advance in technical education a building programme of £15 million will be approved for 1961-62 and that programmes for 1962-63 and 1963-64 will be provisionally set at the same figure. This total programme of £45 million is expected to involve consequential expenditure of £9 million on equipment.

The £70 million building programme for the five-year period covered by the 1956 White Paper up to 1961 is progressing steadily. Building projects under this plan for new colleges or major extensions now number 359, and in 1958 the amount of work started amounted to £15 million. Local education authorities will now be able to continue to plan their building work two years in advance.

The new three-year programme will provide for further increases in the output of advanced students in science and technology beyond the level of 15,000 a year which the plans announced in the White Paper were designed to make possible; a further expansion in educational provision for technicians and craftsmen to match the training opportunities which it is industry's task to provide for the growing number of young people who will be available for employment; and improving existing facilities in the colleges not only for teaching but also for social and recreational purposes, including hostels.

Stresses in Alternator Rotors

IN a publication of the Institution of Mechanical Engineers Dr. H. Fessler (Nottingham University) describes a method of determining the distribution of centrifugal stresses in turbo-alternator steel rotors, using the frozen-stress photo-elastic technique. Excluding the central inspection bore (for which the stresses are readily calculated from the classical theory of elasticity), the greatest stresses occur at the main tooth neck, for which an equation for a concentration factor is derived empirically. Conditions for the lowest mean stress across the main tooth neck are also derived and combined with the empirical equation to determine the best winding for any rotor. Semi-circular subslots and interslots with semi-circular roots (the stresses at which are unimportant) reduce the peak stress at the neck. Regarding stresses caused by the thrust of the winding slot wedges, recommendations for the shape and position of the notches containing the latter are made.

Dynamic Braking of A.C. Motors

SIMULTANEOUS USE OF CAPACITORS AND D.C. INJECTION

By S. A. CHOUDHURY, B.Sc., A.C.G.I.*

The author describes an electrical system of dynamic braking for a.c. motors which makes simultaneous use of capacitors and d.c. injection. The method is applicable to standard 50–60 c/s machines and offers favourable characteristics for use in machine tool applications where accurate positioning is necessary

MANY different methods of braking are employed for the control of electric motors; some are mechanical and others electrical. The method of braking (patents pending) discussed in this article falls into the category of electrical types where the braking torque is produced internally in the motor between the stator and the rotor. More particularly it is that branch of electrical braking where the power is absorbed in the motor itself and not returned to the supply system as in the case of regenerative braking. The braking in this case always takes place below synchronous speeds of the motor.

The different electrical methods of braking may be classified as below:

(1) Plugging, where the supply connections are reversed to produce a counter torque.
(2) D.c. injection, where direct current is passed through the motor winding. The nature of the torque is the same as for accelerating torque for induction motors but for constant current and not constant voltage, with the value of slip reversed, i.e. slip being unity at synchronous speed and zero at standstill.
(3) Use of capacitors across motor terminals to produce self-excitation, to be explained later.
(4) Discharge of a previously charged capacitor through the motor winding. This is similar to d.c. injection under (2), but the value of d.c. is very high at the start and gradually decays to zero.
(5) Single-phase excitation of the motor winding to produce a pulsating field with the addition of producing a short circuit in the quadrature axis either using a separate winding or by suitable connection of a three-phase winding.
(6) Single-phase excitation of special braking windings.

Out of the above methods, (1) and (2) are most commonly used either because of the simplicity of control or the ease with which accurate braking characteristics can be quickly calculated.

The merits and demerits of the above methods will now be briefly stated. In the case of plugging the control is simple and the method gives high braking torque. However, as there is always a reversal torque present, the supply has to be switched off as the speed approaches zero, otherwise there is a risk of the motor running up in reversed direction. This is not always easy. Moreover, the rotor loss is the highest of all the above methods, being three times the loss for d.c. injection.

The d.c. injection method gives a smooth deceleration except just before stopping when the braking torque is highest. To obtain good braking torque a high value of d.c. is required, being about three or four times the value of a.c. full-load current. If this high current is not quickly switched off, it will produce high losses in the motor. Generally the d.c. is obtained through transformers and a bridge rectifier. This means that the ratings of these will have to be high. Moreover, when the rectifier is connected across the motor terminals there may still be high voltage present. To protect the rectifier from failure due to high peak inverse voltage, a choke-resistance or choke-capacitor filter is necessary. The d.c. injection method is better suited for slipring than squirrel cage motors.

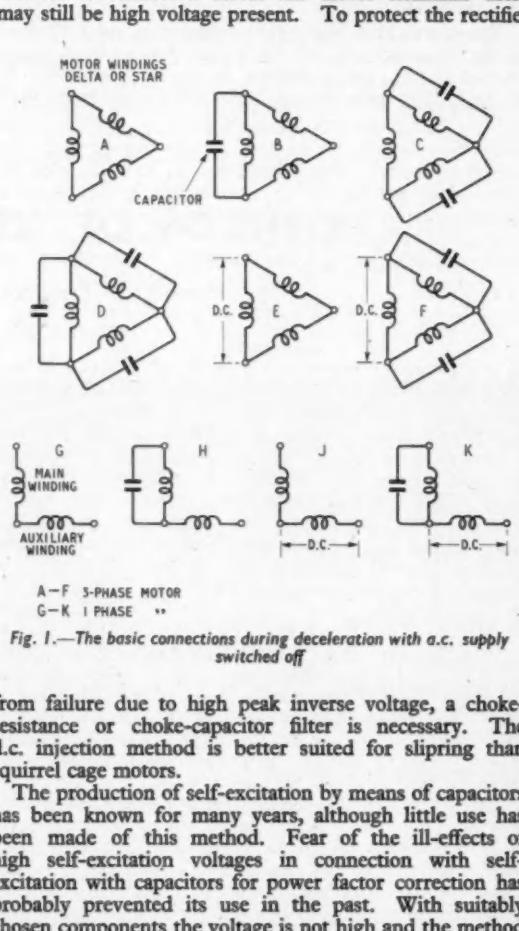


Fig. 1.—The basic connections during deceleration with a.c. supply switched off

The production of self-excitation by means of capacitors has been known for many years, although little use has been made of this method. Fear of the ill-effects of high self-excitation voltages in connection with self-excitation with capacitors for power factor correction has probably prevented its use in the past. With suitably chosen components the voltage is not high and the method gives very efficient braking, the motor losses being the

* Motor Engineering Department, B.T.H. Co., Ltd.

lowest of all electrical methods. The disadvantage is that the method cannot bring the rotor to rest.

The principle of using a capacitor discharge is theoretically sound, as all that is required is to make the stored energy of the capacitor greater than the total kinetic energy at the motor shaft. For large motors this may need enormous capacitors at supply voltage or very high voltage capacitors charged through transformers and rectifiers, neither being convenient. If the load has higher inertia than estimated, the capacitor discharge may not bring the motor to rest, in which case it will crawl.

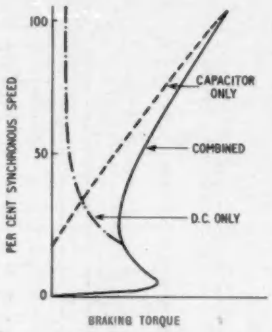


Fig. 2.—Speed-torque characteristics (approximate)

Single-phase excitation is simple but does not produce high braking torque for normal squirrel cage motors. The method may be very satisfactory for slipring motors where suitable external resistances can be connected in the rotor circuit. In this case also supply has to be quickly switched off when the rotor comes to rest, to avoid excessive loss.

Single-phase with special windings may be effective but requires special machines. The new method described in this article combines the advantages of d.c. injection and capacitor self-excitation; both are applied simultaneously so that additional switches are not involved. Immediately the motor terminals are disconnected from the supply, capacitor or capacitors and d.c. circuits are connected to the motor terminals as shown in the various basic diagrams in Fig. 1. Self-excitation of the capacitor (to be described later) produces an a.c. voltage on the motor terminals at a frequency lower than that corresponding to the rotor speed. In other words, the rotor speed is higher than that which corresponds to synchronism at the frequency of self-excitation and, therefore, according to induction motor theory, a braking torque will be produced. The torque due to self-excitation has a peak value at synchronous speed and is the main braking torque in the upper speed ranges.

By suitable choice of capacitors it may be possible to reduce the motor speed to an eighth of its normal value with capacitor alone, so that a major part of the kinetic energy at the motor shaft is neutralised by the capacitor. The d.c. comes into action only when the capacitor self-excitation ceases and has to neutralise only a minor part of the kinetic energy left. The value of d.c. is therefore very small and need not be any greater than half to full value of the a.c. nameplate current.

As the d.c. is small, large variations will not have any appreciable effect on the total stopping time and for frequent starting and stopping d.c. can be left on through the stopping period, thus simplifying control.

Both the voltage and the frequency of self-excitation fall as the speed reduces, unlike the condition during normal acceleration or deceleration due to "plugging" where these are constant. As a result there is more or less a constant ratio between the self-excitation frequency and rotational frequency to give an efficient condition for production of torque. Combined with this, are the low losses due to the value of d.c. chosen. The arrangement thus gives the minimum losses of all methods of dynamic braking so that more starts and stops can be carried out for a certain temperature rise than by any other electrical method. An idea of the reduction of losses can be gained from the fact that in a squirrel cage induction motor stator copper loss due to self-excitation during braking has been found to be 23–30 per cent of stator loss during acceleration.

Control can be arranged for only one contactor with four normally open and two normally closed contacts to perform the function of starting and stopping. Suitably chosen capacitors make the self-excitation voltage for a 50 c/s machine very much lower than the supply voltage, e.g. it may be 150–200 V r.m.s. for 400/440 V supply. If the rectifier is suitably chosen this makes it possible to dispense with the choke-resistance filter, as is used for d.c. injection only. This is not difficult as the rectifier current is a fraction of the value required for d.c. injection alone to produce the same braking effect.

Like all electrical methods it has the advantage of not having any wear and tear in the braking device itself as in the case of mechanical brakes and therefore, once installed, will require very little labour for maintenance. There will be normal wear and tear in the contactor.

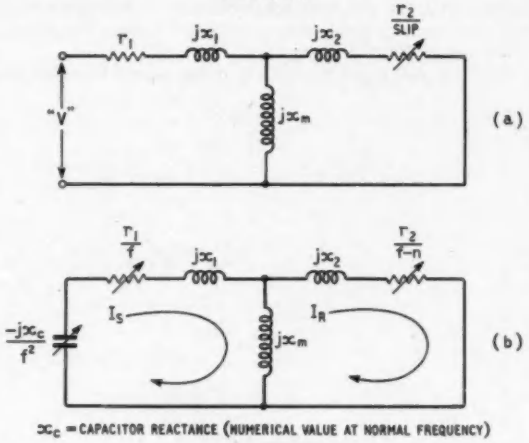
Speed-Torque Characteristic

The torque is maximum at synchronous speed and decreases as the speed is reduced, until at a low speed (say $\frac{1}{5}$ to $\frac{1}{10}$ synchronous speed) the frequency of self-excitation becomes very low. The value of capacitance becomes very high and exceeds the magnetising reactance of the machine at that frequency and, therefore, self-excitation can no longer be sustained. The voltage disappears and with it, the resulting torque.

Unfortunately the speed-torque characteristic cannot be *accurately* calculated. It is well known that in the calculation of torque produced by d.c. injection, complications arise due to saturation of the machine especially when a high value of d.c. (e.g. three to four times the full-load nameplate current) is used.

Conditions become many times more difficult in the case of self-excitation due to capacitor. Several variables play important parts which are all inter-related, viz., frequency, voltage, the degree of saturation and capacitance. Furthermore, the magnetising reactance (xm) under heavily saturated condition must be known to predict the torque. This is extremely difficult. There is never a steady state

Fig. 3.—Equivalent circuits. (a) For running. (b) For capacitor braking only



x_c = CAPACITOR REACTANCE (NUMERICAL VALUE AT NORMAL FREQUENCY)

$f = \frac{\text{SELF EXCHANGE FREQ.}}{\text{SUPPLY FREQ.}}$

$n = \frac{\text{SPEED}}{\text{SYNCHRONOUS SPEED}}$

of the different constants because as the self-excitation voltage is being built up, it is beginning to change. However, approximate guide figures can be obtained by assumed saturation.

Speed-torque characteristics can be determined for a few typical machines on test by suitable apparatus with any value of capacitor for any basic arrangements of Fig. 1. A typical shape is shown in Fig. 2, together with that of d.c. injection and the combined effect. What is more important for practical application is a method of predicting suitable values of capacitors. As a guide to this, the theory will be briefly explained.

Theory of Self-Excitation

The standard equivalent circuit of an induction motor is given in Fig. 3 (a). The same circuit would represent the dynamic braking condition if voltage " V " is removed and the capacitor reactance takes its place as in Fig. 3 (b). Slight modifications in the constants are necessary as the stator frequency and rotor speed are variable quantities.

Let f = stator self-excitation frequency as a ratio o supply frequency, i.e. when f = 1, the frequency is the supply frequency;
and n = rotor rotational frequency in terms of synchronous condition, i.e. when n = 1, the rotor runs at synchronous speed;
$-jx_c$ = capacitor reactance at normal frequency.

To refer quantities to supply frequency, the resistances are divided by " slip " as in an induction motor which is " f " for stator and f-n for rotor. The capacitive reactance has to be divided by (slip)^2, which is f^2 in this case. This gives the quantities in Fig. 3 (b). Stator and rotor currents are shown as I_S and I_R. From stator and rotor loops two equations are obtained involving I_S and I_R elimination of which gives an equation involving real and imaginary parts each of which is equated to zero to satisfy condition for self-excitation.

The solution gives a quadratic equation in " f," the values of which for n = 1, i.e. at synchronous speed, are approximately unity, or

$$\frac{1}{1+\frac{r_2}{r_1}\times\left(\frac{x_m}{x_2+x_m}\right)^2}$$

To produce dynamic braking the rotor slip has to be negative, i.e. the rotor must run at a higher speed than the synchronous speed corresponding to stator frequency. This means that f-n is negative.

Since at full speed n is nearly unity, then f must be less

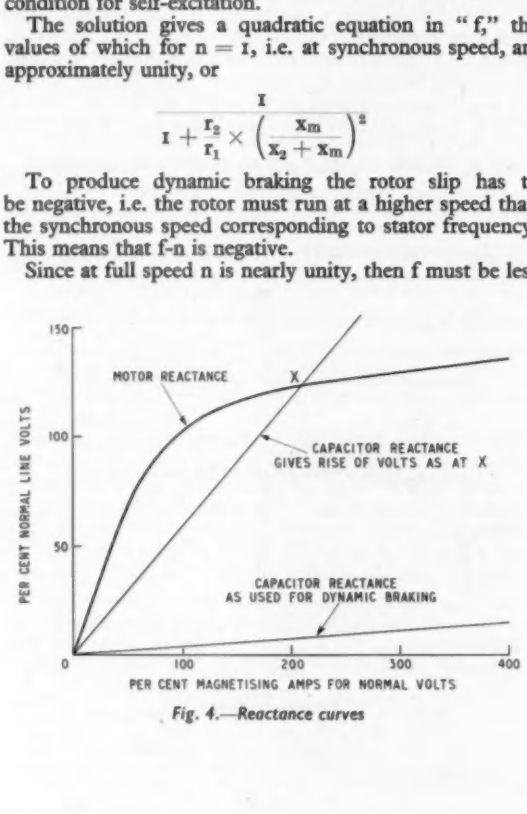


Fig. 4.—Reactance curves

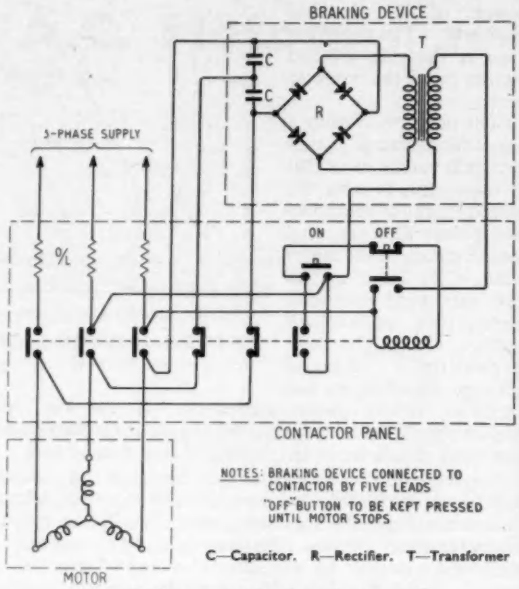


Fig. 5.—Basic circuit for three-phase control

than unity. The condition for efficient dynamic braking is therefore:—

$$f \simeq \frac{1}{1+\frac{r_2}{r_1}\times\left(\frac{x_m}{x_2\times x_m}\right)^2}$$

If $r_1 = r_2$ and $x_m = 3 \times x_2$ during saturated condition

$$f = \frac{1}{1+\left(\frac{3}{4}\right)^2} = \frac{1}{1{\cdot}56}$$

A figure obtained for a 5 h.p. four-pole squirrel-cage motor was $f = \frac{1}{1{\cdot}5}$ which means that for a 50 c/s supply the excitation frequency is 33. Even lower frequencies are obtainable.

Capacitor Value

The equations previously mentioned lead to the following alternative conditions if r_1 is small compared to x_m during saturation:—

$$\frac{x_c}{f^2} = x_1 + x_m \text{ or } x_1 + \frac{x_2}{1+\frac{x_2}{x_m}}$$

The first gives a comparatively low value of capacitor and the second a very large value which is chosen for dynamic braking. The largest value of capacitor which will give consistent self-excitation is the best value since this will give the lowest speed at which the self-excitation can be sustained.

An empirical formula which gives a guide to the value of capacitor to be used is given by the following, where the impedance is measured between points where the capacitor is connected.

$$x_c = \frac{\text{line to line short circuit impedance}}{2}$$

which for 50 c/s supply gives

$$= C(\mu F) = \frac{6{,}000}{\text{short circuit impedance}} \text{ (approximate)}$$

Even a simpler formula can be used as a guide to the capacitors needed.

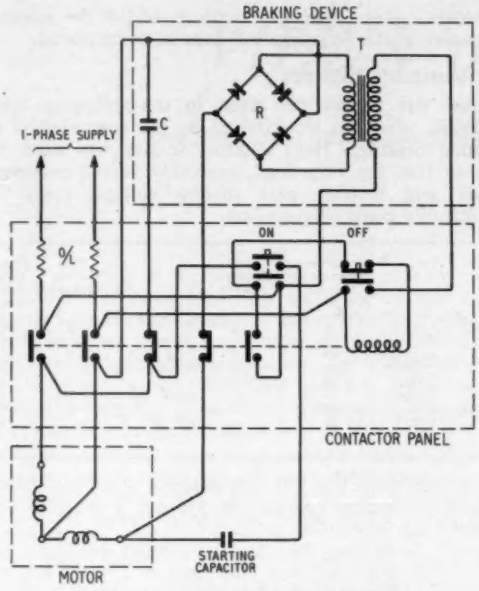


Fig. 6.—Basic circuit for single-phase control

For motors on 400/440 V, 50 c/s, three-phase supply:—

$C(\mu F) = 100 \times$ h.p. for single s.c. motors

$C(\mu F) = 60 \times$ h.p. for double s.c. motors

Fig. 4 gives the reactance lines for the capacitor as used for dynamic braking in comparison with the magnetising reactance curve and also gives a clear picture of how it differs vastly from the capacitor reactance line, which gives trouble due to rise of voltage above supply from self-excitation. Fig. 5 shows how "running" and "braking" can be carried out by pushbuttons using a single contactor for a three-phase motor, while Fig. 6 shows the corresponding arrangement for a single-phase capacitor motor.

Care is necessary in designing the rectifier as two a.c. voltages are impressed on it simultaneously. One is the normal secondary voltage of the transformer supplying the a.c. terminals of the rectifier and the other is the capacitor self-excitation voltage impressed on the d.c. terminals; the rectifier thus acts as a half-wave rectifier for self-excitation voltage. It is not easy to visualise the value of the peak inverse voltage of the rectifier, but the following considerations will make the points clear.

Fig. 7 (a) shows the bridge rectifier with the transformer and motor self-excitation voltages V_T and V_M respectively. Generally, V_M will be very much greater than V_T. The ratio may vary between 4 : 1 and 10 : 1.

Consider the moment when the value of V_M is maximum. The peak potential between A and B is $\sqrt{2}\ V_M$. Let the polarity be such that the rectifier does not conduct. The potential lines for points A and B can be represented by the two lines A and B in Fig. 7 (b). If V_T is absent then the potential of points C and D will lie on the line M which is midway between A and B. When the voltage V_T is applied, the potentials of C and D will move up and down from the line M, in opposite directions. Let the maximum up and down movements be represented by potential lines C and D, the potential being equal to $\sqrt{2} \times V_T$. The potential between A, D and also B, C is clearly seen to be $\frac{\sqrt{2}\,V_M}{2} + \frac{\sqrt{2}\,V_T}{2}$ i.e. $\frac{V_M + V_T}{\sqrt{2}}$ whereas at this instant A, C and B, D will have potentials $= \frac{V_M - V_T}{\sqrt{2}}$. Since, due to alternating voltage, positions of C and D can easily be interchanged, the peak inverse potential on each arm of the bridge can be] $\frac{V_M + V_T}{\sqrt{2}}$.

Deceleration

Most of the deceleration takes place under the influence of the capacitors and d.c. plays only a very small part. This is shown in the typical deceleration curve in Fig. 8. The value of d.c. may be as low as half the nameplate full load current but if the load inertia referred to the motor shaft is several times that of the rotor itself, higher values of d.c. may be required for quick stopping. The shape of the curve in Fig. 8 gives the following relationship.

$$\text{Mean rev/sec} = \frac{\text{synchronous r.p.m.}}{220}$$

From this equation the total time required to stop the motor in a certain number of revolutions can easily be obtained. Thus, a four-pole motor has to be stopped in $\frac{1}{7}$ sec to make one revolution during braking.

Peak Braking Torque

Peak braking torque is produced at the top speed and its value can be obtained from the total stopping time as discussed under "Deceleration" and the slope of the deceleration curve in Fig. 8. To simplify the equation involving peak torque, the time is determined in seconds to give a speed reduction of 300 r.p.m. from the top speed. Calling this t_{300}, the equation becomes

$$\frac{\text{Peak braking torque}}{\text{F.l. torque}} = \frac{WR^2/FLT}{t_{300}\ (\text{sec})}$$

Here, WR^2 is the total inertia referred to motor shaft in lb-ft^2 and FLT is the motor full load torque in lb-ft. The value of t_{300} can be obtained from Fig. 8, knowing the total stopping time, or it can be obtained from the formula: $t_{300} = k$ times the total stopping time, where k for machines with different numbers of poles is as below, corresponding to the curve in Fig. 8:—

Poles	2	4	6	8	10
k	·04	·08	·12	·17	·22

As an example assume that a 5 h.p. squirrel-cage motor

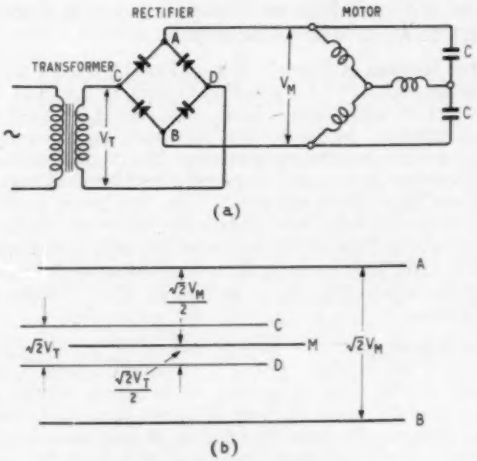


Fig. 7.—Rectifier inverse voltage

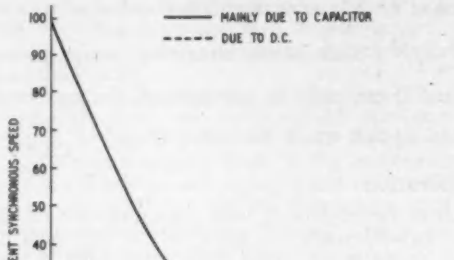


Fig. 8.—Typical deceleration curve. Due to the presence of rotating as well as steady magnetic fields the curve may be wavy, the amount of deviation depending on the value of d.c.

is required to be stopped in one revolution without external inertia.

FLT at 1,430 r.p.m. = 18·4 lb-ft
WR^2 = rotor inertia = ·81 lb-ft² (assumed)

$$\text{Mean rev/sec} = \frac{1{,}500}{220} = 6{\cdot}8$$

Stopping time for 1 rev = ·147 sec
t_{800} = ·08 × ·147 = ·0118 sec
WR^2/FLT = ·0437

$$\frac{\text{Peak torque}}{FLT} = \frac{{\cdot}0437}{{\cdot}0118} = 3{\cdot}7$$

Thus, it is not harmful to stop the above motor in one revolution. For larger machines $\frac{WR^2}{FLT}$ will progressively increase as will the value of peak torque in terms of FLT.

Moreover, when external inertia is added the number of revolutions for stopping will have to be increased.

Performance Figures

Some test figures are given in the following table indicating what can be achieved by the new method of dynamic braking. High external inertia was used for tests so that the behaviour, especially of self-excitation voltage and rectifier peak inverse voltage, could be satisfactorily noted on recorders.

Motor h.p.	Syn. r.p.m.	External inertia times rotor inertia	Basic conn. Fig. 1	μF	D.c. times f.l. amps	Stopping time, sec
5 (3ph)	1,500	14	A	0	0	180
5	1,500	14	B	640	0	42
5	1,500	14	C	530+530	0	35
5	1,500	14	D	530+530+530	0	27
5	1,500	14	E	0	1	13
5	1,500	14	F	400+400	·75	1½
3 (1ph)	3,000	30	G	0	0	390
3	3,000	30	J	0	·75	17
3	3,000	30	K	1,200	·75	3½

The large capacitor was necessary for the 3 h.p. motor because the supply voltage was 230/240 V whereas that for the 5 h.p. motor was 400/440 V.

It will be noticed that capacitor values are large, but due to the fact that even for 400/440 V machines the maximum self-excitation voltage was approximately 150 V and the duration of that voltage less than 1 sec, it was possible to use electrolytic capacitors. The long time for stopping with capacitor alone as seen in the table is mainly due to the creeping period after the self-excitation has disappeared, which may be useful for some machine tool control applications.

Finally, the matter discussed here is applicable to standard machines on 50/60 c/s supply. Machines for high frequencies, say 100–300 c/s, require special consideration. The new method of dynamic braking offers favourable characteristics for use in machine tool applications requiring accurate positioning.

The author wishes to thank the British Thomson-Houston Co., Ltd., for assistance and permission to publish the article.

ELECTRICAL RESEARCH REPORTS

COPIES of the following reports are available, at the prices indicated, from the Electrical Research Association, Thorncroft Manor, Leatherhead:—

Arc Ignition of Gases.—Report Ref. D/T104 "Combustible Industrial Gases—Possibilities of Ignition by Particles of Light Alloys Heated by Arcing or by Frictional Impact" by W. B. Whitney (price 12s 6d) briefly summarises experiments involving sparks produced by the blowing of fuse wires and also by frictional impact between light alloys and steel. The first are of interest in connection with the operational safety of electrical equipment and the second in connection with installations where there may be risks of accidental or other impact between steel (e.g. tools) and light alloy casings or coverings.

Isohexane Ignition.—Report Ref. D/T107 by E. R. Wooding and F. Shaw (price 6s) covers the determination of the relative ease of ignition of isohexane vapour by the sparks produced when an inductive circuit is broken. The most readily ignitable mixture of isohexane vapour with air has been shown to be in the range 117-126 mg/litre. The minimum ignition current has been determined for various circuit inductances and differs only slightly from the values obtained for normal hexane. The work was carried out by the Safety in Mines Research Establishment.

Gas Breakdown Between Electrodes.—Measurements of breakdown stress have been made for hydrogen, nitrogen, air and neon over a range of pressures and at frequencies of 9·5 Mc/s and 5·5 Mc/s; the results are given in report Ref. L/T365 "Ultra-High-Frequency Gas Breakdown Between Rogowski Electrodes" by W. A. Prowse and J. L. Clark (price 18s). Properly profiled Rogowski electrodes of four different diameters were used, and the gap was irradiated to reduce statistical lags. Sufficient precision was achieved to establish that the u.h.f. breakdown stress in each gas showed a decrease with increasing gap width, in accordance with the diffusion theory of breakdown. In a given gas, all the results for u.h.f. conditions could be expressed by a single curve relating $E\Lambda$ and $p\Lambda$ where Λ is the diffusion length of the gap. The results thus give support to the applicability of the diffusion theory of u.h.f. breakdown when sustained oscillatory fields are used between parallel plane electrodes.

VIEWS on the NEWS

By REFLECTOR

THERE has been some fun about the college of the North Western Gas Board at Mere, Cheshire. Because there is no gas supply available in the district the college has resorted to electric cooking and other electrical applications although the Board says it is using its own coke for heating. The *Manchester Guardian* reports that a spokesman for the Board

> "explained that it was a question of weighing one job against another and was involved with supplies for new housing estates. The Board would be considering it and the moment it became economic to lay on a gas supply, this would be done."

In the meantime members of the Board's staff and the Area Gas Consultative Council have expressed some strong opinions. They are no doubt afraid that students at the college will graduate into the wrong industry.

* * *

A correspondent with a Canadian address writes to the *Scottish Field* asking whether "power hungry Scotland should be deprived of cheap electricity, solely to satisfy a purely æsthetic pleasure enjoyed by such a small proportion of the community." He questions a statement by a previous writer that Glen Nevis gives pleasure to thousands of tourists and says that in reality not one in fifty thousand visitors has ever been there, "although his statement could become correct with the advent of an access road built by the Hydro Board." He goes on to suggest that the appearance of the glen would be enhanced by the presence of a loch (presumably also provided by the Hydro Board). I believe it is true that the Board has improved the tourist traffic of the Highlands as well as bringing power to the area.

* * *

Official guides' stories are frequently very imaginative but sometimes their fiction is more amusing than mere fact. A writer to the *Manchester Guardian* tells of a visit to Westminster Abbey when a guide brought a party to the "Scientists' Corner." He drew attention to Lord Kelvin's memorial and explained:—

> "Lord Kelvin was the inventor of the refrigerator—the Kelvinator refrigerator. Lord Kelvin . . . William Thompson as was, was an Australian sheep farmer. And he found that his sheep were going rotten between Australia and England. So he invented the refrigerator, and he made a lot of money, and so they made him Lord Kelvin."

* * *

A month ago I commented on the pleasure expressed by miners and their wives at Kilsythe, Stirlingshire, at the all-electric houses provided by the local council. A contrary feeling has been engendered in another mining district, Broadacres, Bardon Mill, Northumberland, by the Haltwhistle Rural Council's decision to install electric cookers in its new houses. The Scottish edition of the *Daily Herald* says that the miners' wives have asked the Council: "Take us back to the days of coal ovens." But the Council's surveyor has replied:—

> "However many petitions the housewives send, things cannot be changed now. There aren't any chimney stacks for coal ovens. It would cost us a fortune to build them in."

* * *

It is rather pleasing to me to see in an electrical journal circulating in the United States (the home of the gigantic) an advertisement by a British company claiming to be "the world's greatest cablemakers." Adapting its language to the reader the company says:—

> "Being the world's greatest cablemakers is not just a matter of size. It's also, generally speaking, a case of knowing more than the other guy."

Three outstanding achievements are referred to:—A 33 kV ductless shaped-conductor oil-filled cable; the cabling at Calder Hall; and the 330 kV cable for the Kariba scheme. These may enable readers to identify the company.

* * *

Dealing with public investment in the current financial year, the *Municipal Journal* says that the £1,607 million is by no means all to be spent by local authorities. This total "covers much of the national landscape"—rather an infelicitous phrase when a list which follows includes the Electricity Council.

* * *

Revival of interest in electric runabouts in the United States lends interest to a note which I have found in the *Electrical Review* of 26th May, 1889, which reads as follows:—

> "On Wednesday the London Electrical Cab Company placed upon the London streets 80 electric cabs. Our readers will be aware of the fact that for the past few weeks these cabs have been undergoing overhauling and alteration at the company's works. On Wednesday several mishaps occurred to them, for we read that in Fleet Street one of the vehicles collided with a trap, damaging a wheel and stripping off the tyre. On Ludgate Hill one 'became unmanageable,' and ran into the back of a 'bus, smashing the cab splashboard and shaking the occupants. As the driver of a following cab was feeling for his colleague he smashed into the vehicle in front and damaged his own cab. A fourth collided with an Epsom coach in the neighbourhood of Farringdon Road. Three other cabs also sustained damages of various kinds. We cannot help thinking it somewhat strange that the return of the cabs to the streets should be accompanied by so lengthy a list of accidents, particularly when one bears in mind the fact that for the many months that they previously plied for hire they ran so well."

Restrictive Practices and the Public Interest

IN delivering a judgment the Restrictive Practices Court are usually careful to point out that their decision is dependent on the facts of a particular case and does not necessarily afford a guide to other cases where different circumstances exist. Nevertheless, sufficient cases have now been heard to make it clear that legislation embodied in the Restrictive Trade Practices Act is extremely rigid in operation and that there is, in particular, great difficulty in satisfying the requirements regarding the public interest.

Under the Act all registered agreements must be brought before the Court. An agreement is deemed to be contrary to the public interest unless it can satisfy one of seven narrowly defined conditions and the parties can in addition prove that the advantages to the public outweigh any detriment. To satisfy the most general of the conditions it is necessary to show that removal of a restriction would deny to the public "specific and substantial" benefits. It is not sufficient to show that an agreement is innocuous.

Why the Valve Agreement was Abandoned

In view of the decision of the Court on the Yarn Spinners' Agreement, the British Radio Valve Manufacturers' Association decided not to bring any evidence before the Court and they abandoned their agreement on 30th March. The restrictions in the agreement formed a three-tier structure with "exclusivity" as the base. Above that there was a system of limitation of the numbers of those who were entitled to wholesalers' terms; and above that there was the limitation of the maximum discount which applied. Prices have not been the subject of Association agreement for three years.

In giving an undertaking at the recent hearing that the Association would not re-introduce the restrictions, or introduce similar restrictions, Sir Lionel Heald, Q.C., counsel for the B.R.V.M.A., said that in view of the publicity that the case had attracted in advance he felt he should be allowed to state the Association's attitude and why they had decided to take the action they had.

Sir Lionel said that the B.R.V.M.A. consisted of a number of highly efficient and reputable companies, and the origin and building up of the Association had been of benefit in creating a strong and stable industry which in consequence had been able to withstand the evil influences of the 1920s and 1930s, chiefly from foreign competition. It was essential to have a vital and efficient industry and the Association might well have proved that that had been the effect of their operations. To have satisfied the Court, however, it would have been necessary to have shown that the exclusivity on which the main restriction was based was a necessity at the present time—that it was specific and substantial benefits existed at the present moment. The Association was not in a position to do that because as a result of its operations over many years, the companies were now in a position in which they were able to stand against foreign competition.

Once it had been decided, Sir Lionel continued, that exclusivity could not be justified because it was too general, the whole structure of the restrictions fell to the ground. Nevertheless, he thought there were considerable benefits in the restrictions. The mere uncontrolled allowance of discounts was not a desirable thing in that it was a temptation to the supplier not to give the public any benefit by way of reduction in price, and in the end might even mean the manufacturer increasing his price. Similarly with the limiting of the number of dealers it was arguable whether or not a multiplicity was in itself an advantage.

Commenting on the proceedings, Mr. G. A. Marriott, vice-chairman of the B.R.V.M.A., said that the Association had been operating continuously since 1926, and had for some time been putting the major part of its efforts into technical and engineering activities. "This work will, of course, go on without interruption and it is expected that there will be many other ways in which the Association will be able to serve the interests of its members."

When is the Public Concerned ?

The difficulty of proving the "specific and substantial" benefit required by the Act was further emphasised by the earlier decision on the agreement of the Blanket Manufacturers' Association.

Here the Court allowed the Association's resolution relating to quality standards, but other resolutions concerning terms of sale, and including one on minimum prices, were declared contrary to the public interest. On the question of sanctity of contracts the Court held that it had no jurisdiction.

It is interesting that even in respect of the minimum price agreement no detriment to the public was alleged. On the resolution regarding limitations on the supply of patterns to the trade, the Court's decision stated that: "The resolution appears to be reasonable and fair, but the benefit to the public is too small to be described as substantial." On another resolution, which stated that all orders should be booked at a firm price, the Court said: "This seems to us to be essentially a matter for negotiation between manufacturer and wholesaler or retailer, and the public has no real interest in this matter."

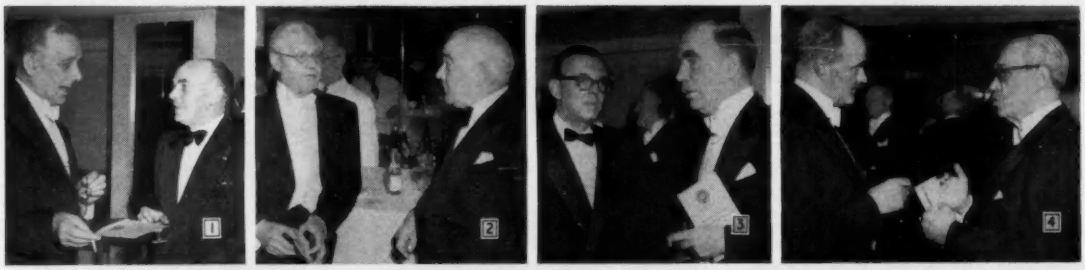
The judgment of the Court follows logically from the strict legal interpretation of the Act which it is obliged to take. But it would seem to be hardly in the public interest for a great deal of time and money to be spent in investigating and declaring illegal harmless agreements that do not affect the public one way or another. It would also seem to be far from the original purpose of the Act to discourage in this way all forms of association. It is true that the Board of Trade can, under Section 12, remove agreements that are of no economic significance; and this was done in the case of the recommendations on conditions of contract issued by the Structural Steelworks Association. But it would be more satisfactory to amend the Act so that the work of the Court is concentrated on agreements, or those parts of agreements, that are definitely considered to operate against the public interest.

Legislation in Germany

In this respect experience in other countries may be helpful and the Federation of British Industries have performed a useful service by publishing a comparison of British and German legislation on restrictive practices.* The German law, in direct opposition to that in this country, virtually forbids all restrictive practices, but goes on to provide a wide range of exceptions from this ban, subject to certain conditions and at the discretion of the Federal Cartel Office. As the author picturesquely puts it: "The British pick off their victims one by one; the Germans lay them all low at one swoop but allow some to get up again one by one."

Another important difference is in the responsible public authority. The British Restrictive Practices Court is a judicial body and has little discretion to do more than apply the statute to the facts. In Germany, on the other hand, the Federal Cartel Office is an administrative authority and has considerable discretionary power and freedom to negotiate for changes in agreements. However, British manufacturers are better placed in respect to resale price maintenance. Though a final comparison will have to wait until more agreements have been worked through, the author concludes that German law seems somewhat more flexible and offers to the authorities more opportunities to adapt their policy to the economic needs of the moment.

* *F.B.I. Review*, March, 1959.



1. *Rear-Admiral K. R. Buckley and Sir Willis Jackson.* 2. *Sir Ben Lockspeiser and Sir Ben Barnett.* 3. *Herr Hans Von Herwarth and General Sir Brian Robertson.* 4. *Sir Harold Bishop and Senor Luders de Negri*

Electrical Supervising Engineers

THE annual dinner and reunion of the Association of Supervising Electrical Engineers was held on Friday last at Grosvenor House, London, with Sir Josiah Eccles (president) in the chair.

General Sir Brian Robertson (chairman, British Transport Commission) proposed the toast of "The Electrical Industry and the A.S.E.E." and referred to the close connection between the B.T.C. and the electrical industry. He confessed that he himself dated from the oil lamp era. He said that in his lifetime things had changed very much, but in the railway industry it had seemed for many years that things had "stood still"; this was due to lack of money. Four years ago he had announced the Modernisation Plan in which electrification was a dominant factor and the work had gone ahead with urgency. So far everything was going according to plan. The high voltage a.c. system was relatively new to this country and gave rise to some technical problems but these were being solved. Unfortunately he was not happy about the overall situation. The schedule originally planned was not quick enough. He thought the answer was close co-operation between the electrical industry and the railways.

Apart from electrification there was a big scheme for diesels too. They could be put into operation quickly and many multiple-unit trains were doing very well. With regard to costs, Sir Brian said that electrification was expensive and took a long time to carry out. The diesels were being used in view of the commuter (peak hour) traffic. Without going too deeply into the subject, he said that the cost of peak hour electricity was an important and "tender" subject which might decide the issue.

Looking at things on a broader basis, he said that the British electrical industry had exported goods and equipment valued at £276 million last year. French railways had gone in for electrification in a big way and now they were selling well overseas. It could happen here too.

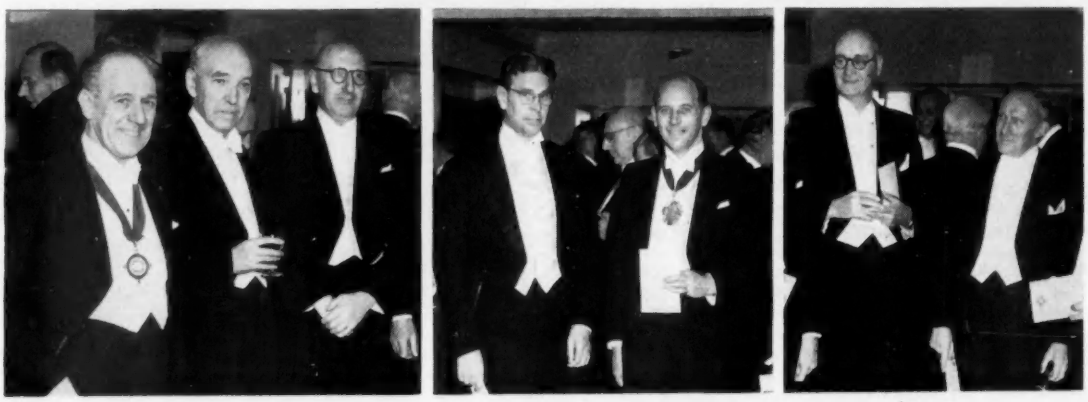
The response was made by Mr. S. E. Goodall, President of the Institution of Electrical Engineers, who said that Sir Brian was becoming one of their largest customers and he seemed not too dissatisfied with this state of affairs. The electrical industry was proud of the quality of the goods it supplied and its reputation was based on solid achievement. The A.S.E.E. had the reputation of being extremely helpful. He could vouch for this in his capacity as vice-chairman of the Wiring Regulations Committee of the I.E.E. He knew that the A.S.E.E.'s "Guide to the Wiring Regulations" was an extremely valuable document.

The strength of the electrical industry lay not in machines and equipment but in men, and the A.S.E.E. had done much to weld together a vast body of men who formed the core of the industry. Mr. Goodall said that the I.E.E. was happy to have close associations with the A.S.E.E. There was a considerable measure of common membership between the two organisations and they had a number of common aims, particularly in the field of education and training. Mr. Goodall concluded by saying how pleased they all were with this year's A.S.E.E. Exhibition.

Also responding to the toast proposed by General Sir Brian Robertson, Mr. J. H. K. Pendry, chairman of the A.S.E.E., spoke about the work of the Association. He also referred to the export activities of the electrical industry.

Sir Josiah Eccles proposed the toast to the guests and a response was made by Mr. J. K. Vaughan-Morgan, Minister of State, Board of Trade.

Left to right: Mr. J. H. K. Pendry, Sir Josiah Eccles and Mr. S. E. Goodall; Mr. J. K. Vaughan-Morgan and Councillor David Cobbold; Sir Henry Self and Mr. E. R. Wilkinson



PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Power has reappointed **Sir George Turner,** K.C.B., K.B.E., of Gulval, Penzance, as a part-time member of the South Western Electricity Board. **Mr. L. V. Turner,** M.I.E.E., of Taunton, will retire from the Board on 31st May on completion of his present term of office.

Mr. P. K. Davis, M.I.E.E., formerly transmission engineer (construction) of the Eastern Division of the Central Electricity Generating Board, has been appointed divisional electrical engineer of the Division. After a period of active service with the Royal Engineers, Mr. Davis completed his training at Faraday House in 1924, following which he held the position

Mr. P. K. Davis

Mr. C. L. Jaques

of assistant engineer with British Insulated Cables, Ltd. He then joined Messrs. G. V. Twiss & Partners, consulting engineers, and later was with Messrs. Merz & McLellan, consulting engineers. He commenced his service in the electricity supply industry in 1932 with the Electricity Board for Northern Ireland as mains superintendent and was appointed superintendent of the Outside Department of the North Metropolitan Electric Power Supply Co. in 1936. From 1948 to 1955 he held the position of senior assistant transmission engineer (construction) of the Eastern Division, following which he became transmission engineer.

Mr. C. L. Jaques, M.I.Mar.E., M.Inst.F., has been appointed chief generation engineer of the Eastern Division of the C.E.G.B. He began his engineering career as an apprentice marine engineer, and then served six years with the New Zealand Shipping Co., Ltd. After a further six years with the British Xylonite Co., Ltd., and then with Clarke, Chapman & Co., Ltd., he joined the Bradford Corporation Electricity Department. In 1938 he went to the County of London Electric Supply Co., at Barking, being transferred to assist in the commissioning of Littlebrook "A" station. He inaugurated the Mechanical Maintenance Department there and in 1944 returned to Barking on similar duties, becoming deputy station superintendent in 1945. Mr. Jaques was appointed station superintendent at Barking in 1948 and held this position until 1951 when he was appointed generation engineer (southern) in the Eastern Division.

The Electrical Contractors' Association of Scotland branches have made the following appointments at their annual meetings held during the month. Glasgow and West of Scotland Branch: Chairman, **Mr. G. MacKinlay** (George MacKinlay & Co., Ltd.). Lanarkshire Sub-Branch: Chairman, **Mr. D. Fisher** (David Fisher (Burnbank), Ltd.). Dundee Branch: Chairman, **Mr. F. O. Leslie** (John Campbell). Perth Sub-Branch: Chairman, **Mr. A. Brown** (Burrelton). Edinburgh Branch: Chairman (reappointment), **Mr. A. C. C. Smith** (William Allan Smith & Co., Ltd.).

The Secretary of State for Scotland has appointed **Lord Strathclyde** to be chairman of the North of Scotland Hydro-Electric Board from 1st July next to 30th June, 1962, in succession to **Mr. Thomas Johnston,** C.H., LL.D. Lord Strathclyde was a director of the Clyde Valley Electrical Power Co. for some time prior to and up to the nationalisation of the electricity supply industry in 1948.

Mr. E. C. Scott, B.Sc.(Eng.), M.I.E.E., system operation engineer of the North Eastern Division of the C.E.G.B., has been appointed system operation engineer at the Board's headquarters. Mr. Scott was educated at Dundee High School and later at St. Andrews University. He served a college apprenticeship course with the Metropolitan-Vickers Electrical Co., Ltd., becoming a junior engineer in the Meter Engineering Department. After holding appointments with the Perak River Hydro-Electric Power Co. he joined the Central Electricity Board, South West England and South Wales Area, in 1933 and on the nationalisation of the industry in 1948, Mr. Scott was appointed as the engineer responsible to the system operation engineer at headquarters and held this position until 1951, when he acted as personal technical assistant to Sir John Hacking. He joined the North Eastern Division as system operation engineer in 1953.

Mr. K. Baldwin has been appointed information officer to the Merseyside and North Wales Electricity Board in succession to **Mr. G. M. Davies,** who was recently appointed press and information officer to the Electricity Council. Mr. Baldwin was a Merseyside journalist for a number of years before joining the Board's staff early in 1958 as assistant to Mr. Davies. He will be responsible for the Board's press liaison and public relations work, and will edit the house magazine, *Contact,* together with other publications produced on behalf of the Board.

Nearly 400 persons were the guests of the Lord Mayor and Lady Mayoress of Liverpool at a reception and dance held in the Liverpool town hall on 14th April in connection with the golden jubilee celebrations of the **Illuminating Engineering Society.** Officials of the I.E.S. who attended included Mr. C. C. Smith (national president), Mr. G. F. Cole (general secretary), Dr. W. E. Harper (hon. secretary), Mr. Tom Jones (chairman, Liverpool Centre) and the chairmen of other centres.

On the following day there was an I.E.S. Council meeting in the town hall, and the Lord Mayor entertained Council members to lunch.

The annual luncheon for members of the No. 6 District Negotiating Bodies took place in Nottingham on 10th April. Later a presentation in the form of a pair of silver candelabra

Presentation to Mr. J. Mould. Left to right: Mr. R. Barker (chairman, No. 6 District Joint Industrial Council), Mr. Mould, Mr. J. R. A. Hardy (chairman, No. 6 District Joint Board) and Mr. L. R. Barker (chairman, No. 6 District Joint Council)

A group at the first dinner-dance of the Southern Centre of the Institution of Electrical Engineers held at Brighton on 10th April. Left to right: Mr. L. H. Fuller (past chairman), Mrs. Fuller, Mr. W. D. Mallinson (vice-chairman), Mrs. Mallinson, Mr. W. Stewart (headmaster, Brighton College), Mrs. Stewart, Mr. A. H. Mumford (vice-president), Mrs. Mumford and Mr. H. W. Housley (hon. secretary)

was made to **Mr. J. Mould,** chairman of the East Midlands Electricity Board, who retires at the end of this month.

The B.B.C. has appointed **Mr. S. W. Amos** B.Sc.(Hons.), A.M.I.E.E., as editor, technical instructions, Engineering Training Department, in succession to **Mr. J. W. Godfrey,** F.R.S.A., who is retiring after being with the B.B.C. for thirty years.

Mr. Amos, who joined the Corporation in 1941 as a maintenance engineer, has been assistant editor, technical instructions, since 1957. He was the joint author with Mr. D. C. Birkinshaw of a series of four volumes on "Television Engineering" (Iliffe & Sons).

The annual luncheon of the **Diesel Engineers' and Users' Association** was held at the Connaught Rooms, London, last week. The president of the Association, Mr. D. S. Dodsley Williams, A.M.I.Mech.E., reviewed the activities of the Association during 1958 and proposed the toast to the guests, to which Major-General G. N. Russell, C.B., C.B.E., chairman, British Road Services, British Transport Commission, and president of the Institute of Transport, replied. Major-General Russell then proposed the toast to the Association and Mr. H. D. Adam followed by thanking the president for the excellent way in which he discharged his duties during the past year.

Mr. E. J. Lassen, who has been export manager of Bakelite, Ltd., since the Export Unit was established in 1945, has retired after twenty-eight years' service with the company. He is succeeded by **Mr. G. H. Johnson,** deputy export manager.

Mr. D. L. Walker, C.B.E., general secretary of the Federation of British Industries, retired on 9th April after forty-two years in the Federation's service. He has been elected a vice-president and has agreed to accept the appointment of honorary adviser to the Federation. The following consequential changes in the F.B.I. staff organisation have been made:—In the absence overseas of the Director-General, **Mr. P. F. D. Tennant,** C.M.G., O.B.E., overseas director of the Federation, will act in his place on F.B.I. matters; and **Mr. W. P. N. Edwards,** C.B.E., will take charge of British Overseas Fairs, Ltd., as managing director. **Mr. J. Gough,** hitherto assistant general secretary, becomes secretary, and **Mr. J. Whitehorn,** hitherto a member of the General Secretary's Department, becomes assistant to the Director-General.

The Deputy Lord Mayor of Bradford (Councillor J. N. Horsfall) and the Deputy Mayor of Keighley (Councillor J. H. Waterworth) were among the guests at the annual dinner of the Bradford Branch of the **Electrical Contractors' Association** held at the Victoria Hotel, Bradford, on 17th April. The toast to the Association and Allied Associations was proposed by Mr. A. Tiley, M.P. for Bradford West, who suggested that the electrical industry also needed glamour. Many people had the idea that it was below the standing of the arts and there was need for more publicity. Mr. C. R. Waterhouse, vice-president of the Association, responding, said the industry had advanced considerably in the last ten years, due to attractive tariffs, hire purchase and other factors, but the part played by the electrical contractor and retailer should not be forgotten. He appealed for co-operation within the industry and support for the scheme for training young technicians and craftsmen. Mr. K. B. Joist, social secretary, proposed the toast to the guests, to which Mr. J. R. Burnet, captain of the Yorkshire County Cricket Club, responded.

Mr. L. Rotherham, M.Sc., F.Inst.P., F.I.M., member for research of the Central Electricity Generating Board, has been co-opted to the Council of the British Welding Research Association.

Mr. G. A. Oliver, D.F.H., M.I.E.E., who has been works manager of the Hackbridge Cable Co. since 1954, has resigned from that company to become general works manager of the General Cable Manufacturing Co. and its subsidiary, Britannic Cables, Ltd. Mr. Oliver received his technical education at Faraday House and joined Hackbridge Cables in 1930. He is a member of a number of committees dealing with cable design development and standardisation.

The eleventh annual dinner of the Meter Engineers' Technical Group of the **Electrical Power Engineers' Association** took place at the Palmerston Restaurant, London, last Friday. Following the loyal toast, the vice-chairman, Mr. A. T. Bailey, A.M.I.E.E., proposed the toast to the guests. He emphasised that the success of the Group had depended largely upon the guests at the dinner. Dr. G. F. Tagg, B.Sc.(Eng.), M.I.E.E., replied on behalf of the guests. The health of the chairman was proposed by Mr. H. S. Petch, B.Sc.(Eng.), M.I.E.E., meter and test engineer, London Electricity Board. The present chairman, he said, had been very successful in a rather thankless job and he thought that Mr. Slater must be the Group's youngest chairman. In reply, Mr. W. G. Slater, London area manager, Sangamo Weston, Ltd., thanked the company for their kind response to the toast and the committee and secretary for their work during the past session. After the dinner Leslie Sarony entertained the company.

Messrs. S. G. Leonard, F. G. Axleby, D. J. Sells, A.M.I.E.E., and **D. R. de Selincourt,** A.C.A., have been appointed to the board of Rashleigh Phipps & Co., Ltd.

Johnson & Phillips, Ltd., have appointed **Mr. S. Slingsby,** M.I.E.E., M.I.Prod.E., as production manager. Mr. Slingsby, who was previously works manager of Gresham Transformers, Ltd., received his early training with the English Electric Co. Ltd. and he is well known in the industry for his service on various B.S.I. and B.E.A.M.A. technical committees.

Mr. S. Slingsby

Herman Smith Smithlite, Ltd., announces that **Mr. W. H. Blackford,** commercial manager, has been appointed to the board in the capacity of commercial director. Mr. Blackford joined the company in 1948 as lighting engineer, was appointed sales manager in 1949 and commercial manager in 1956. He joined the company from Ekco-Ensign Electric, Ltd., and before that was with Crompton Parkinson, Ltd.

The annual reunion dinner of the **F.B.I. Overseas Scholars** was held at the Connaught Rooms, London, on 14th April. The toast to the guests was proposed by Mr. W. H. McFadzean, the newly elected president of the Federation of British

Industries, and the response was made by Sir David Eccles, President of the Board of Trade. The dinner was attended by Ambassadors or representatives from the majority of the countries from which the scholars come. Representatives from the Government, the firms participating in the scholarship scheme and a number of prominent industrialists also attended.

At the first general meeting of the Audio Manufacturers' Group of the British Radio Equipment Manufacturers' Association, held in London on 14th April, **Major J. F. E. Clarke** (chairman and managing director, Clarke & Smith Manufacturing Co., Ltd.) was elected chairman of the Group.

To cope with increased business in the Reading area, the General Electric Co., Ltd., has transferred its Reading branch office from Castle Street to new premises in Basingstoke Road (telephone: Reading 84251). The manager of the new branch is **Mr. G. T. Leworthy,** D.F.C., who was previously with the Sales Department at the company's Southampton branch. After military service during the last war Mr. Leworthy joined the head office staff of the G.E.C. and subsequently was transferred to the Southampton branch.

Mr. G. T. Leworthy

Ewbank & Partners, Ltd., announce that they have retained, in an advisory capacity, the services of **Mr. C. H. Sparks,** M.A., M.I.C.E., M.I.E.E.

Fawcett Preston & Co., Ltd., Bromborough, which is part of the Metal Industries Group, has appointed **Mr. C. Smith** as contracts manager in the Electrical Division and **Mr. A. J. Taylor** as sales office manager.

We regret that in reporting the performance of "Sailor Beware" by the **G.E.C. Amateur Dramatic Society** in our last issue we said that the part of "Emma Hornett" was played by Anna Powell; actually Miss Powell was "Edie Hornett" and Mary Andrew was "Emma."

Mr. H. Walker, B.A., M.I.P.M., has been appointed assistant manager, staff recruitment and training. After graduating at Cambridge University in 1939, Mr. Walker was commissioned in the Loyal Regiment; attached to the Indian Army Infantry, he served in Burma during 1942-44, later acting as staff captain, 14th Army. He joined the Metropolitan-Vickers Electrical Co. in 1948, in the Education Department, transferring to the Personnel Department in 1952 and becoming chief assistant, staff recruitment and supervisory training, in 1957. Mr. Walker is secretary of the Manchester Branch of the Institute of Personnel Management.

The directors of Bruce Peebles & Co., Ltd., have approved the formation of a divisional board of management and the following appointments have been made thereto:—**Mr. W. M. McKenzie,** F.C.I.S. (administration), **Mr. R. W. Flux,** A.M.C.T., M.I.E.E. (transformers), **Mr. D. McDonald,** B.Sc., A.M.I.E.E. (engineering), **Mr. J. H. P. de Villiers,** A.H-W.C., M.I.E.E. (rotating plant), **Mr. N. L. Jones,** Associate I.E.E. (sales) and **Mr. J. W. Haig-Ferguson,** M.A., A.M.I.Mech.E., A.M.I.E.E. (electronics).

Mr. McKenzie will retain the secretaryship. Mr. McDonald has been appointed chief engineer of the company.

The company has also announced the appointment of **Mr. C. Phillips,** A.I.Mech.E., A.M.I.P.E., as general works manager and of **Mr. G. Anderson,** M.B.E., M.Inst.W., as assistant general works manager.

Mr. A. H. Hird, A.C.G.I., B.Sc., M.I.Mech.E., has been appointed to the board of the English Steel Corporation, Ltd. He is a director of Vickers, Ltd., and a number of its subsidiary companies.

Dr. A. R. Billings, lecturer in electrical engineering at Bristol University, has been appointed Professor of Electrical Engineering at the University of Western Australia.

Mr. R. C. Stevens, A.C.W.A., has been appointed assistant sales manager of Clarkson (Engineers), Ltd., Nuneaton. This is a new appointment, made necessary by the growth of the Clarkson sales organisation, and it carries responsibilities for the eight home branches as well as overseas branches. Mr. Stevens has recently returned from Canada where he was manager of Clarkson Engineering (Canada), Ltd.

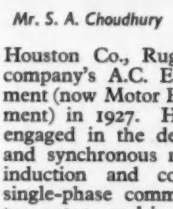
The latest production of the **Portland Players** (Central Electricity Headquarters' Sports and Social Club), was "Here Welcome Gathering," a comedy by Philip King and Anthony Armstrong, which was presented at King George's Hall, London, W.C.1, on Monday and Tuesday last week. The play, which centres around a married couple who have acquired a cottage in the country and run into difficulties and inconveniences through the non-arrival of the furniture, gives plenty of scope for broad humour, and the players made the most of their opportunities. We particularly liked the portrayals of the Rev. James Kellaway by David Forrest and George Hawkins (one of the furniture removal men) by Brian Drinkwater. Barbara Hughes and John Robson were Anne and Philip Kellaway (the married couple), and were well supported by Dorothy Stannard, as Harriet Kellaway (the domineering mother-in-law), John Ashton as Gray Meredith, Eileen O'Leary as Shirley Cameron, Dagmar Weate as Evadne Potter, and Edward Errington as Luke Betterworth. The play has been entered for the electricity supply industry drama competition. In previous competitions the Players have been placed 2nd (with "Blithe Spirit") and 4th (with "The Noble Spaniard").

The annual dinner of the **Scientific Instrument Manufacturers' Association of Great Britain** was held on 10th April at the Dorchester Hotel, London. Among the speakers were Sir David Eccles, President of the Board of Trade, Mr. R. Barrington Brock, the Association's president, and Miss Anona Winn. During the evening a presentation was made to Mr. P. Goudime, past-president, in recognition of his work for the Association during his year of office.

Mr. C. G. Rieck and **Commander A. R. Bradshaw** have been appointed directors of the Lindley Thompson Transformer & Service Co., Ltd. **Mr. J. Lindley Thompson** and **Mrs. Frances A. Thompson** have resigned from the board.

Mr. N. T. Burgess, metallurgist with the Aluminium Development Association, is leaving at the end of this month to join the Research and Development Department of the Central Electricity Generating Board, as welding metallurgist.

Mr. S. A. Choudhury, B.Sc., A.C.G.I., who writes in this issue on "Dynamic Braking of A.C. Motors" (page 760), gained the London University B.Sc. degree with first-class honours and the diploma of the City and Guilds Institute. After completing his apprenticeship with the British Thomson-Houston Co., Rugby, he joined the company's A.C. Engineering Department (now Motor Engineering Department) in 1927. He was successively engaged in the design of alternators and synchronous motors, three-phase induction and commutator motors, single-phase commutator and capacitor motors, and is now engaged in the design of selsyns of all descriptions including power selsyns for industrial synchronous drive. Mr. Choudhury is responsible for the development and application of the capacitor and also combined capacitor and d.c. injection dynamic braking.



Mr. S. A. Choudhury

Miss Dorothy Smith, Assoc.M.C.T., M.I.E.E., retired on 31st March after forty-three years' service with the Metropolitan-Vickers Electrical Co.,

Presentation to Miss Dorothy Smith who is seen seated in the centre with Mr. H. West, Metropolitan-Vickers assistant managing director, and with her colleagues in the Motor Engineering Department

Ltd. For most of this time an engineer in the Motor Engineering Department, Miss Smith is well known in the electrical industry as one of the very few women to have achieved election (in 1958) to full membership of the Institution of Electrical Engineers. She has also been prominent in the Women's Engineering Society, being chairman of the Manchester Branch from 1943 to 1945 and continuously a member of the Council since 1947. Mr. H. West, assistant managing director of the Metropolitan-Vickers Co., recently presented her with a radio set and domestic electrical appliances on behalf of her colleagues in the Motor Engineering Department.

Mr. A. Williams, group general manager of the Denis Ferranti Group, has been appointed to the board of Denis Ferranti Meters, Ltd., Bangor, and the Denis Ferranti Co., Ltd., Royton, Lancs. He joined the Denis Ferranti organisation in 1952 and was appointed group general manager in 1957.

Mr. G. R. Browne, chairman and managing director of M.T.E. Control Gear, Ltd., is leaving by air on 12th May for South Africa, in order to complete arrangements for the sub-assembly and marketing of the company's "Progress" range of products in the Union. He will be visiting Johannesburg and Cape Town.

At the annual general meeting of the North East Coast Institution of Engineers and Shipbuilders held on 17th April **Mr. E. J. Hunter,** B.Sc. (chairman, Swan, Hunter & Wigham Richardson, Ltd.), was elected president for 1959-60 and **Mr. L. T. Morton,** C.B.E., B.Sc. (joint managing director, Clarke, Chapman & Co., Ltd.), was elected a vice-president.

Mr. T. D. Shillcock has been appointed manager of the Bristol branch of the Simplex Electric Co., Ltd. Mr. Shillcock, who has been in Bristol for the past two years, was previously one of the company's sales engineers in the Midlands and has been with Simplex for twenty-one years.

Mr. E. W. Short has been appointed chief cashier of W. T. Henley's Telegraph Works Co., Ltd., in succession to the late Mr. G. W. Thorn. Mr. Short joined Henley's as a junior in the Accounts Department in 1918 and transferred to the Cashier's Department in 1923.

At the annual dinner-dance of the **Crompark London Staff Club** (Crompton Parkinson, Ltd.) held at the Connaught Rooms, London, recently, various awards for long service were presented by Mr. E. C. Holroyde, vice-chairman of Crompton Parkinson, including an award to Mr. J. B. Scott, the company's sales director, who is also chairman of the Club.

Mr. C. L. Champion, B.Sc., A.C.G.I., M.I.C.E., M.I.Mech.E., A.M.I.E.E., has been appointed chief mechanical and electrical engineer of the War Office Directorate General of Works. His address is the War Office, Chessington, Surrey (telephone: Trojan 2491).

Mr. W. C. M. Couch, C.B., C.B.E., M.I.E.E., Deputy Director of Electrical Engineering at the Admiralty, retires from Admiralty service at the end of this month after nearly fifty years' service. He was one of the earliest dockyard electrical fitter apprentices to be awarded the Admiralty scholarship in electrical engineering and he studied at the Royal Naval College, Greenwich, from 1914 to 1916. He subsequently served at Admiralty headquarters, Admiralty Engineering Laboratory, West Drayton, and at dockyards at home and abroad. In his present post, which he has occupied since 1937, he has been responsible for the development and design of equipment and installations of all kinds for the generation, supply, distribution and utilisation of electrical energy in all classes of warships. He led an important Admiralty-C.M.A. Mission to the United States in 1955 in connection with the development of silicone insulated electric cables for H.M. ships. Mr. Couch was made a C.B.E. in 1946 and a C.B. in 1956. He was president of the Batti-Wallahs' Society for 1956-57.

Mr. W. C. M. Couch

Mr. N. Hill, who recently joined Air Trainers Link, Ltd., as head of the Sales Division on the resignation of Mr. L. Malec, has been appointed a director of the company. **Mr. D. P. Markham,** formerly chief instrument engineer of Matthew Hall & Co., Ltd., has been appointed head of the Industrial Products Division of Air Trainers Link, Ltd.

At the annual dinner of the **G.E.C. Witton Apprentices' Association,** held recently in Birmingham, some 350 apprentices, ex-apprentices, and life members of the Association were present. Mr. A. L. G. Lindley, assistant managing director of the company, proposed the toast to the Association, to which Mr. N. Gardner, chairman of the Association, replied. The guest of honour was Canon Bryan Green, who responded to the visitors' toast proposed by Mr. T. Lings, vice-chairman of the Association. During the evening awards were made to the various apprentices by Mr. J. J. Gracie, director and general manager of the Witton Works. The evening concluded with a revue written and produced by the apprentices.

OBITUARY

Sir Stanley Angwin.—We regret to learn of the death of Sir Stanley Angwin, K.C.M.G., K.B.E., M.I.C.E., Hon.M.I.E.E., a past-president of the Institution of Electrical Engineers. Sir Stanley entered the Post Office Engineering Department in 1906, becoming Engineer-in-Chief in 1939. From 1947 to 1951 he was chairman of Cable & Wireless, Ltd.

Mr. J. Newton, who retired from the position of manager of the Norwich branch of W. T. Henley's Telegraph Works Co., Ltd., in 1954, died on 11th April after a brief illness, at the age of seventy. He was with Henley's for forty-five years.

Mr. E. R. Parton.—The death occurred in a Colchester nursing home on 19th April, at the age of fifty-eight, of Mr. E. R. Parton, of Dedham, who was for over ten years the transport officer of the Eastern Electricity Board. Mr. Parton was electrical engineer to the Sudan Railways from 1928 to 1949.

Mr. Arthur Benjamin Mallinson, M.I.E.E., M.I.Mech.E., consulting engineer, died on 18th April, in his eighty-second year.

Mr. J. A. Chalmers, managing director of Andrew Chalmers & Mitchell, Ltd., manufacturing electrical engineers, Glasgow, died on 16th April.

Financial Section

STOCKS and SHARES

THE speech of Lord Chandos at the annual meeting of Associated Electrical Industries contained, as usual, much matter of general interest to investors in the electrical industries. In view of the comparatively recent absorption of Associated Insulation Products, W. T. Henley's and the London Electric Wire Co. into the A.E.I. group, and of amalgamation moves by other companies, attention has been attracted particularly to the chairman's view that modern circumstances are encouraging the tendency towards the formation of ever larger units in the industry. Discussing the failure of the A.E.I. group's earnings to rise last year on a scale commensurate with the expansion of output, Lord Chandos ascribed this largely to the heavy initial expenses in starting new plants and expected this factor to be of less importance in the current year. On the subject of the A.E.I.–John Thompson Nuclear Energy interest, he revealed that this company's contracts will result in substantial losses, although not of a size to affect seriously the group's net profit. A.E.I. shares have been firmly supported around 60s, at which price they yield 5 per cent on the 15 per cent dividend.

Enfield Merger

Early market reactions to the proposed merger between Enfield Rolling Mills and Enfield Cables resulted in a fall of about 1s 6d in the former company's £1 ordinary shares, to 45s 6d, and an improvement of 1s in the Cable £1 shares, to 19s. Terms of the proposed share exchange, namely two E.R.M. shares and 7s 6d cash for every five Cable shares, put a present value of about 19s 9d on each of the latter. Other announcements made at the same time concerned E.R.M.'s acquisition of Barker & Allen, and the passing of the Enfield Cable ordinary dividend.

Dividend Positions

If the conditions are fulfilled for the implementation of the Enfield merger, Cable shareholders who accept the share-exchange offer will be entitled to participate in E.R.M. ordinary dividends declared in respect of the current year. For 1958 this company raised the payment from 12 to 15 per cent from earnings equivalent to approximately double that rate on the present capital. In a statement accompanying the proposals, the directors of E.R.M. draw attention to the advantages of creating a stronger unit in view of the re-grouping in the cable industry. Directors of Enfield Cables are accepting the offer in respect of their own interests and advise shareholders to do the same.

Mixed Changes

References at the A.E.I. meeting to losses sustained on nuclear energy contracts were thought to be responsible for dullness in the shares of some of the electrical and heavy engineering groups. Reyrolle lost 3s 3d to 90s x.d., G.E.C. and Babcock & Wilcox receded

Price Changes in

Company or Board	Nom. Value	Middle price 20th April	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78½	−½	3	3	3 16 6	80½	77½
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	77	74½
Brit. Elec. 1976/79	100	79		3½	3½	4 8 6	80½	77½
Brit. Elec. 1974/79	100	89		4½	4½	4 15 6	90½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	18/-		6·8†	7†	13 10 0	17/3	16/-
East African Power	£1	20/-	−9d	7½	8	8 0 0	22/3	19/3
Nigerian Elec.	£1	14/6		10	10	13 16 0	15/-	13/9
Perak Hydro-Elec.	£1	13/6	−1/-	12½	10	14 16 6	14/6	12/3
Electrical Shares								
Aberdare Holdings	5/-	16/-		17½	17½	5 9 6	16/3	15/6
Aerialite	1/-	9/3		51½	54	5 16 6	9/6	7/9
Allen, W. H.	£1	45/-		10	11	4 17 9	45/-	43/-
Anglo-Portuguese Tel.	£1	28/3		8	9	6 7 6	29/3	26/6
Aron Elec. Ord.	£1	57/6		15	15	5 4 3	61/6	57/6
Assoc. Elec. Ord.	£1	60/-	+1/3	15	15	5 0 0	61/-	53/9
Automatic Tel. & El.	£1	80/-		17	17	4 5 0	82/-	77/6
Babcock & Wilcox	£1	51/3	−1/3	15	13‡	5 1 6	53/9	45/6
Bakelite	10/-	27/-		15	15	5 11 0	27/6	22/-
Baldwin, H. J.	2/-	2/6	−6d	20	20	—	3/-	2/3
Berry's Electric	5/-	15/6	−3d	10	10	3 4 6	15/9	10/9
Bowthorpe Holdings	2/-	15/3	+9d	37½	25*	3 5 6	15/3	11/9
British Elec. Traction: Def. Ord. "A"	5/-	38/-	+1/6	25	25	3 5 9	40/-	35/6
B.I. Callender's	£1	52/6	−3d	12½	13½	5 2 9	53/-	44/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/6	19/9
British Thermostat	5/-	40/9	+9d	25	30	3 13 6	40/9	37/-
British Vac. Cleaner	5/-	7/6		10	7½*	5 0 0	7/9	4/6
Brook Motors	10/-	53/9		25	24½*	4 10 0	54/-	46/-
Bulgin, A. F.	1/-	8/9x.d.		45	50	5 14 3	9/3	6/9
Bulpitts	5/-	12/6		—	15	6 0 0	13/-	10/-
Burco Dean	5/-	13/3		22½	16*	6 0 9	13/3	12/3
Cable & Wireless: Ord.	5/-	14/-		10	10*	3 11 6	14/-	12/3
4% Loan	100	94½		4	4	4 4 9	95	93
Chloride El. Storage "A"	£1	79/6	+5/3	17½	20‡	5 0 9	79/6	65/6
Clarke Chapman	£1	61/3		27½	13‡*	4 9 9	66/3	60/-
Cole, E. K.	5/-	18/3		17½	17½	4 16 0	21/3	17/3
Contactor Switchgear	5/-	13/-	+6d	20	14*	5 7 9	13/-	12/-
Cossor, A. C.	5/-	8/9	+6d	2½	Nil	Nil	9/-	6/3
Crabtree	10/-	31/-		20	20	6 9 0	31/6	28/-
Crompton Parkinson	5/-	14/-	+6d	16	12*	4 5 9	14/-	11/9
Davis & Timmins	5/-	14/6	+6d	18	20	6 18 0	15/3	14/6
De La Rue	10/-	35/-	+6d	35	17½*	5 0 0	35/-	30/3
Decca "A"	4/-	33/9	−6d	43½	50	5 18 0	40/3	33/9
Desoutter	5/-	25/3	+2/-	32½	21½*‡	4 5 9	25/3	19/-
Dewhurst	2/-	7/6		20	20	5 6 9	8/3	7/3
Dictograph Tel.	2/-	7/9		20	20	5 3 3	7/9	7/-
Dubilier Condenser	1/-	3/9		30	20*	5 6 9	4/-	3/3
Duport	5/-	11/-		25	12½*	5 13 9	11/-	10/3
E.M.I.	10/-	56/-	−9d	15	20*‡	3 11 6	64/6	50/-
Electrical Apparatus	5/-	13/6		12½	14½	5 2 6	14/-	13/-
Electrical Components	5/-	11/6		12½	12½	5 8 9	11/9	10/6
Elec. Construction	£1	30/-		8½	8½	5 13 3	30/3	27/9
Elliott-Automation	5/-	23/9	+3/-	—	10‡	2 2 0	23/9	16/9
Enfield Cable Ord.	£1	19/-	+6d	2½	Nil	—	22/3	16/3
English Electric	£1	64/3	−9d	14	14	4 7 0	65/6	56/9
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/9	12/3
Ericsson Tel.	5/-	23/3		12†	13†	4 17 6	27/3	25/9
Ever Ready	5/-	27/6	+1/-	37½	20*	3 12 9	27/6	22/-
Falk Stadelmann	£1	27/-	−6d	17½	10*‡	7 8 3	32/9	26/3

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

by more than a shilling each to 32s 6d and 51s 3d, respectively, and there were minor setbacks in English Electric and John Thompson. On the other hand, the strong demand for Crompton Parkinson shares persisted up to 14s, and elsewhere in the electrical market the changes were mostly favourable. Among cable shares B.I.C.C., at 52s 6d, retained most of the previous week's sharp rise induced by the improvement reported in the 1958 earnings and dividend. Hackbridge Holdings and Hackbridge & Hewittic both made recoveries, and Telegraph Condenser have gained further ground, to 43s 9d, since the appearance of the full report.

Electrical Investments

Company or Board	Nom. Value	Middle price 20th April	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1959 Highest	1959 Lowest
Electrical Shares—continued								
G.E.C.	£1	32/6	−1/6	12½	10	6 3 0	40/3	31/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9		24	15	8 11 6	9/-	7/6
Greenwood & Batley	£1	81/9	−3d	17½	20	4 17 9	83/9	75/-
Hackbridge Holdings	5/-	15/3	+1/-	20	20	6 11 3	15/6	14/3
Hackbridge & Hewittic	5/-	14/9	+6d	20	20	6 15 6	15/9	13/9
Head Wrightson	5/-	28/6		22½	17½*	3 1 6	28/6	24/3
Heatrae	2/-	9/-		15	20	4 9 0	9/-	7/6
Holophane	5/-	15/6		37½	22½*	7 5 3	16/6	15/6
Hoover	5/-	63/6		50	60	4 14 6	65/3	55/-
I.C.I.	£1	34/6		12	8*	4 12 9	38/3	33/-
Intl. Combustion	5/-	36/3	+6d	25	30‡	4 2 9	36/3	29/9
Intl. Computers & T.	£1	67/6	+1/9	—	8‡	2 7 6	70/3	57/6
Johnson & Phillips	£1	26/3		10	5	3 16 3	30/6	22/-
Lancashire Dynamo	£1	52/6	+9d	11	12½‡	4 15 3	52/6	42/-
Laurence Scott	5/-	17/3		15	15	4 7 0	17/6	16/6
Lister, R. A.	£1	38/6		10	12½	6 9 9	41/-	32/9
Lucas, J.	£1	46/-		7½	10‡	4 7 0	46/6	43/3
Marconi Marine	£1	39/6		10	10	5 1 3	48/6	40/6
Marryat & Scott	2/-	9/6		35	37½	3 19 0*	9/6	8/6
Mather & Platt	£1	44/9	+1/9	15	10½*	4 15 3	51/6	41/3
Metal Industries	£1	45/-		9	14	6 4 6	46/-	39/9
Midland Elec. Mfg.	£1	45/-		12½	10*	4 9 0	45/-	41/6
Morphy-Richards	4/-	22/6		20	20	3 11 0	22/6	18/-
Murex	£1	49/3	+6d	20	17½	7 2 3	49/6	42/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	3/-	+6d	17½	17½	5 16 9	3/-	2/6
Parsons, C. A.	£1	50/-	−2/6	7½	8½	3 5 0	55/9	47/3
Philips' Lamps	Fl.10	111/6	−1/6	14	14	2 7 6	116/-	88/-
Plessey	10/-	78/3	+9d	30	30	3 16 9	78/3	70/6
Pye	5/-	14/6	−3d	12½	12½	4 6 3	16/9	13/9
Pyrotenax	5/-	36/6	−6d	—	27½‡	3 15 3	38/3	33/9
Reliance Clifton	5/-	17/9		13½	15	4 4 6	19/9	17/6
Reyrolle	£1	90/-x.d.	−3/3	17½	17½	3 17 9	98/-	86/6
Rheostatic	4/-	8/9		12½	12½	5 14 3	9/3	8/3
Richardsons Westgarth	10/-	15/3		16¾	8¼*	5 11 0	15/3	13/9
Scottish Cables	4/-	14/9	+6d	27½	27½	4 7 0*	16/3	13/3
Simon-Carves	5/-	32/-	+3d	20	25	3 18 3	32/-	28/6
Smith (England), S.	4/-	13/3		20	12½*‡	3 15 6	13/3	11/6
Southern Areas	£1	10/6	−6d	7½	Nil	Nil	14/9	10/6
Strand Elec.	5/-	8/9		15	15	8 11 6	9/-	8/6
Sturtevant	5/-	17/9		15†	15†	7 7 0	19/-	17/-
Sun Elec.	£1	80/6	+6d	25	25	6 4 3	80/-	66/-
Switchgear & Cowans	5/-	12/3	−3d	22½	15*	6 2 6	13/-	10/3
Taylor Tunnicliff	5/-	22/9		17½	17½	3 17 0	26/-	18/-
T.C.C.	10/-	43/9	+1/3	25	25	5 14 3	43/9	38/-
Telephone Mfg.	5/-	5/6		10	10	9 1 9	5/6	4/9
Telephone Rentals	5/-	13/6		12½	12½‡*	4 12 6	13/6	11/9
Thompson (John)	5/-	25/-	−6d	25	25	5 0 0	25/6	22/9
Thorn Elec.	5/-	34/6	+9d	17½	17½	2 10 9	38/6	26/3
Thornycroft	£1	23/9		12½	7½	6 6 3	23/9	20/6
Tube Investments	£1	84/6	+1/6	15	17½	4 2 9	85/3	71/6
Vactric	5/-	36/3	−1/3	25	25	3 9 0	44/6	26/3
Veritys	5/-	2/6		12½	2½	—	5/-	1/3
Walsall Conduits	4/-	19/-		20	22½	4 14 9	19/-	16/9
Ward & Goldstone	5/-	40/6		40	25*	3 1 9	40/6	30/6
Watford	2/-	9/-		25	25*	5 11 0	9/-	7/6
Westinghouse	£1	43/9	+1/3	10	10	4 11 6	47/-	39/6
West, Allen	5/-	13/3	−9d	12½	11½*	4 8 0	14/-	11/9
Wolf Electric	5/-	8/3		10	10	6 1 3	8/6	8/-

Chloride Electrical

The shares of Chloride Electrical Storage responded sharply to news of an increase in the company's profits for 1958, an effective increase in the ordinary dividend, and the proposal of a one-for-two scrip issue. While the payment for the past year is maintained at the rate of 17½ per cent paid on the four previous occasions, it is to be augmented by a further 2½ per cent in the form of an interim on account of the current year (presumably on profits-tax considerations). Having been marked up from 74s 3d to 79s 6d, the £1 "A" shares offer a yield of just over 5 per cent on the basis of a 20 per cent distribution. With net profits up by nearly 20 per cent the rate is covered approximately 1¾ times by earnings.

Extra Dividends

Group profits of Lancashire Dynamo Holdings rose by about 12 per cent, to £836,000 before tax in 1958. The final dividend brings the total to 11 per cent, as before, and is to be supplemented by a special 1½ per cent payment on account of 1959, which will not prejudice other distributions for this year; and a one-for-three scrip issue is proposed. Having risen fairly substantially in anticipation of good results, the £1 shares were subsequently about 9d higher at 52s 6d. Taking the dividend rate as 12½ per cent, they show a yield of a little over 4¾ per cent. C. A. Parsons are also making a special interim payment, of five-eighths per cent, in addition to maintaining the dividend for 1958 at 7½ per cent. The £1 shares were quoted lower at 50s after the announcement of a 17 per cent fall in the group trading profits, although after smaller tax and other provisions the net surplus is rather more than before and covers an 8½ per cent distribution nearly five times over.

Company News

Allen West have declared an increase in their dividend, but the accompanying announcement of reduced profits was reflected in an easing of the price of the 5s shares to 13s 3d. The final dividend of 7½ per cent is payable on capital increased by a 20 per cent scrip issue, allowing for which the total for the year is equivalent to 11⅞ per cent, or about 1½ per cent more than last year's. A. C. Cossor 5s shares were raised further to 8s 9d after the company's decision to clear the arrears of preference dividends and the issue of an interim report to the effect that trading is now on a profitable basis. Davis & Timmins 5s shares rose 6d, to 14s 6d, in response to the declaration of a 2 per cent increase in the final dividend, making 20 per cent for the year.

REPORTS and DIVIDENDS

Associated Electrical Industries, Ltd.—The annual meeting was held at the company's new headquarters, Grosvenor Place, London, on 16th April, Lord Chandos (chairman) presiding. In the course of his address to stockholders, Lord Chandos said that the trading profit of £11 million included £1,259,000 arising from the operations of the Associated Insulation Products group and W. T. Henley's Telegraph Works Co. for the whole year, which included a period during which they were not members of the A.E.I. group.

In 1958 the total value of electrical apparatus supplied to customers amounted to £181·5 million and surpassed the previous record of 1957 by £31·5 million. The profits, however, did not increase in step with the increased output. In general, conditions in the electrical industry were not particularly favourable, although the market for domestic appliances was buoyant, and the demand for television tubes and radio valves, after an unpromising start, showed much more promise by the end of the year. On the other hand, the profits on lamps and lighting were negligible, and those in aero equipment and in certain classes of motors showed some fall. The main cause, however, why profits were not more buoyant was that the group was still affected by the initial cost of starting new plants. Thus the Larne factory was still operating at a loss. These influences continued during 1958, but would be of less importance during 1959.

Referring to the A.E.I.-John Thompson Nuclear Energy Co., Ltd., of which A.E.I. owned two-thirds and John Thompson, Ltd., one-third, Lord Chandos said that it had four contracts in hand, three for experimental reactors, of which one was for the A.E.I., and the fourth was the contract for the Berkeley power station. The target date for completion of this contract was 1st January, 1961, and the total period of construction for the two reactors was 48 months. Of these, 27 months had now elapsed and certain broad conclusions on the outcome of the contract seemed to emerge. The most important was that the company would incur substantial losses. They were not, however, of a size to affect markedly the net trading profit of the A.E.I. group, and they had already written off 25 per cent of the estimated total loss. It was impossible at the time the contracts were entered into to assess the difficulties or the modifications entailed by this entirely new venture into the unknown. They had, in common with the other three contracting groups, gained an amount of knowledge, experience and "know-how" which was probably unique in the world and which was likely to prove of great, though unassessable, value in the future. It was natural to feel some regret that the immense technical and engineering effort which had been put into this £40 million project would not result in any immediate profit although it formed the foundation of its future business.

The Siemens Edison Swan group and A.E.I.-Hotpoint showed a satisfactory increase in earnings.

The orders booked by the company during the year totalled £167 million, a reduction of about 5 per cent on the previous year. Over 10 per cent of the business was in consumer goods such as electric lamps and domestic appliances, which hardly figured in the order book. The fall in the total value of orders booked must be read in relation to the previous year's figures, which exceeded by £40 million the highest figures recorded up to that date. In spite of the increased output, they had not been able to reduce the orders in hand by any significant amount and today they stood at £182 million.

During 1958 the orders booked for heavy generating plant had fallen off considerably, as compared with 1957, which was to be expected because of the exceptionally large orders which they then took. During the year, however, they obtained contracts for 965 MW of turbo-generator plant. The great bulk of this business was for export to Argentina, Poland and Spain. Lord Chandos referred to some of the more important contracts received, mentioning the Kariba scheme and orders for Buenos Aires, Australia and Holland.

Although the general volume of demand for mining equipment had not been as great in 1958, they had maintained their position, contracts being received from the National Coal Board and for South Africa. The order book for traction equipment was in a healthy condition and they were continuing to receive a substantial proportion of business from British Railways.

In telecommunications, the General Post Office placed orders with the Siemens Edison Swan group for £2,614,000 in 1958, but it reduced by 70 per cent the delivery rate of contracts for telephone instruments, and new orders which all companies supplying the Post Office were expecting, did not mature. This had a severe effect upon that part of their business, and upon Aldridge Plastics, who made the mouldings for telephone instruments. They had made strenuous efforts, however, to replace the business with export orders for the "Centenary Neophone," and so far the results were encouraging. The business in television tubes and radio valves was satisfactory. The same applied to domestic appliances where the turnover markedly increased.

Lord Chandos then referred to some of the more important contracts completed during the year. They included the commissioning at Blyth of the first 120 MW set in this country, and a fifth 100 MW set at Castle Donington. In the export field the commissioning of two 6·5 MW turbine-generator sets at Wairakei geothermal station in New Zealand was of interest. Two complete stators and other components for five 100 MW waterwheel generators for Bhakra power station in India were shipped, and they commissioned the largest pumpless multi-anode rectifier plant in operation in the world, at the smelter plant of the Canadian British Aluminium Co. at Baie Comeau.

A.E.I.-Hotpoint had launched its new "Countess" washing machine which had established a pre-eminent position. The market in those lines of appliances which they manufactured expanded by 17 per cent, but their sales recorded an increase of 38 per cent. The outlook for A.E.I.-Hotpoint was bright and they had been obliged both to expand the existing plants and to plan future extensions.

They received an order from the Canadian Overseas Telecommunication Corporation for 400 nautical miles of submarine cable and repeaters, to be supplied by Submarine Cables, Ltd. A £250,000 order from Shell Petroleum received by A.E.I. Lamp & Lighting included 12,000 fluorescent lighting fittings. This was probably the largest single contract for interior lighting ever placed in this country.

Speaking of the group's overseas activities, Lord Chandos particularly referred to their interests in India. Their own manufacturing and agency companies had shown increased profits. With regard to their participation in co-operative schemes the most important was "Iscon," where the contract was for building a steel plant at Durgapur. They, as partners in "Iscon" with the English Electric Co. and the G.E.C., were sharing the orders for electrical equipment. Siemens Edison Swan, in conjunction with Pirelli-General, were supplying the entire power and lighting cables and by the end of the year had shipped cables to a value approaching £1 million. In connection with the Indian Government's Five-Year Plan, they had been entrusted with a consultancy contract for the heavy electrical plant at Bhopal. The initial production would be of switchgear and transformers to their designs and it was the intention of the Indian Government to increase the factories to include generating equipment and other heavy plant in the future.

Returning to the acquisition of W. T. Henley's Telegraph Works Co., the chairman said that it raised to over 20 per cent their share of the market enjoyed by the members of the Cable Makers' Association. The tendency in the electrical industry would be towards larger and larger units, and to organisations which covered the whole electrical field rather than some portion of it. The two main reasons were, first, the necessity to draw profits

from diverse sources; often some parts of the industry were booming when others were slack. The second reason was that the Restrictive Trade Practices Act would tend greatly to curtail collective price maintenance by manufacturers. He believed that on broad lines this was for the future health of British industry, but that it would lead to amalgamations and larger units to face keener competition seemed certain. After referring to the acquisition of the capital of the London Electric Wire Co. & Smiths, of which they now held over 93 per cent, Lord Chandos said that after the completion of their two acquisitions they now had 52 main plants in the United Kingdom, apart from feeder and ancillary factories, which would swell the total to about 70.

After referring to research and recruitment, the chairman concluded his statement by saying that the first three months of 1959 showed some, but not a very marked, improvement over 1958, but they looked during the latter part of this year to improved trade.

The London Electric Wire Co. & Smiths, Ltd., which is now controlled by Associated Electrical Industries, Ltd., reports that the group profits for 1958 were £487,693 (against £487,946 for 1957), after heavier taxation of £536,230. General reserve is increased by £217,000 and dividends of 15 per cent (12½ per cent) have been paid, leaving £513,813 to be carried forward.

C. A. Parsons & Co., Ltd.—Group profits for 1958 at £3,381,738 were lower as compared with the 1957 profits of £4,094,911, but after the provision of £50,000 (£80,000) for contingencies, and lower taxation of £1,240,454 (£2,001,263), the net balance is £2,091,284 (against £2,013,648). With the final dividend of 3¾ per cent, making 7½ per cent (same) for the year, the company is paying in addition a special dividend of ¾ per cent for the current year.

Lancashire Dynamo Holdings, Ltd.—The group profits expanded from £746,565 in 1957 to £836,466 in 1958, and after deducting taxation of £446,124, less £6,454 unrequired, the net profit is £396,796 (against £382,721). It is proposed to pay a final dividend of 7 per cent, maintaining the dividend for the year at 11 per cent, and in addition to pay a special bonus interim dividend for 1959 of 1½ per cent. It is stated that the special interim will not prejudice subsequent distributions for 1959. A one-for-three scrip issue is also proposed, involving the issue of a further 726,317 £1 ordinary shares by the capitalisation of reserves.

The Rheostatic Co., Ltd., held its annual meeting on Wednesday last, Mr. M. J. Gartside (chairman and managing director) presiding. In his statement, which had previously been circulated, the chairman said that before the end of 1958 credit relaxations coupled with an unprecedented seasonal increase of demand resulted in a rapid rise in the incoming order rate. The greater part of this increased demand was met from stocks of finished goods and by increase of production, and as a result the accounts showed an appreciable improvement in profit as compared with that of the previous year. Export sales contributed to the results and once again advanced to a level higher than ever before in the history of the company. After dealing with the progress of overseas subsidiaries, Mr. Gartside said, in referring to the current year's prospects, that the order book was satisfactory and production was being increased steadily to meet the growing demand for "Satchwell" temperature controls.

Enfield Rolling Mills-Enfield Cables Agreement.—An agreement has been reached in principle for the acquisition by Enfield Rolling Mills, Ltd., of all the issued share capital of Enfield Cables, Ltd. For each £5 ordinary stock in Enfield Cables holders are offered £2 ordinary stock in Enfield Rolling Mills and 7s 6d cash. For every three 7½ per cent cumulative preference of £1 in Enfield Cables, holders will receive £5 of a new 4½ per cent cumulative preference stock in Enfield Rolling Mills, and the holders of Enfield Cables 4½ per cent cumulative second preference shares of £1 will receive in exchange new 4½ per cent cumulative second preference stock in Enfield Rolling Mills on a one-for-one basis. The new ordinary stock of Enfield Rolling Mills will rank *pari passu* with its existing ordinary stock except that it will not participate in any dividend paid for any period before 1st January, 1959.

Enfield Rolling Mills, Ltd., in a separate circular to its stockholders, states that an agreement has also been reached to purchase as from 30th June last the whole of the share capital of Barker & Allen, a private company whose products include sheet, strip, rod and wire in nickel silver and in the principal copper alloys. The consideration is a cash payment of £450,365 and the issue of 576,550 £1 ordinary shares in Enfield Rolling Mills.

The preliminary statement of the results of Enfield Cables, Ltd., for 1958 shows a profit of £33,472, before taxation, as compared with £90,670 for 1957. It is not proposed to pay an ordinary dividend for the year (against 2½ per cent).

A. C. Cossor, Ltd., in an interim statement, says that the company is now on a profitable basis and the coming year is looked forward to with reasoned confidence. As already reported, the radio and television business has been taken over by Philips Electrical, Ltd., and profits on the rest of the group for the past year, states the chairman, are clearly amply sufficient to cover the preference dividend for the year to 31st March last. Consideration of an ordinary dividend must await the full accounts.

Chloride Electrical Storage Co., Ltd.—The group net profits for 1958, after providing £799,754 for United Kingdom taxation and £338,319 for other taxation, are £899,009, as compared with £756,231 for 1957. It is proposed to pay a further interim dividend (in lieu of a final dividend) of 12½ per cent on the "A" and "B" ordinary stock, and in addition an interim dividend of 2½ per cent for the current year, making the effective distribution for the year 20 per cent (17½ per cent). It is also proposed to make one-for-two free scrip issues of new "A" and "B" ordinary stock.

W. Canning & Co., Ltd., report that after providing £298,732 for taxation, the net profit for 1958 is £245,298 (against £247,873 for 1957). General reserve receives £175,000 and it is proposed to pay a final dividend of 22½ per cent, making 27½ per cent (against 25 per cent) for the year. It is also proposed to make a tax-free distribution out of capital profits of 3 per cent (against 2½ per cent). A one-for-one scrip issue is proposed and also certain alterations in the preference rights cancelling the right of holders to attend meetings in exchange for which the 5 per cent non-cumulative dividend will be raised to 6 per cent cumulative. In addition the 5s preference are to be consolidated into £1 units.

The British Engine Boiler & Electrical Insurance Co., Ltd., reports a net profit for 1958 of £141,006, as compared with £142,612 for the previous year. The dividend is raised from 75 to 80 per cent.

Edwards High Vacuum, Ltd., reports group trading profits for 1958 of £224,035, as compared with £179,636 for 1957, and a net balance, after taxation of £116,767, of £107,268 (against £76,458). It is proposed to pay a final dividend of 12 per cent (against 11 per cent), making 16 per cent (15 per cent) for the year.

Mavor & Coulson, Ltd.—The group net profit for 1958, after providing £314,479 for taxation, is £365,435, as compared with £322,210 for 1957. General reserve receives £160,000 and the final dividend is 5 per cent, maintaining the distribution for the year at 8¾ per cent. The balance carried forward is £162,758 (against £135,816 brought in).

The Harland Engineering Co., Ltd.—After providing £129,258 for taxation, the group net profit for 1958 is £100,264, as compared with £90,915 for 1957. It is proposed to pay a final dividend of 10 per cent, making 14 per cent for the year (unchanged). It is also proposed to make a one-for-two scrip issue.

Kango Electric Hammers, Ltd., which was made public in October last, reports a net profit for 1958 of £31,566, as compared with £31,255 for the preceding year. It is proposed to pay

a final dividend of 7½ per cent, making 22½ per cent for the year. The final dividend is paid on trebled capital. For the previous year the distribution on the smaller capital was 35 per cent.

Hopkinsons, Ltd., report that after a loss of £1,040 on the sale of investments (against a profit of £51,245), the group profit for the year to 31st January last is £913,848 (against £1,021,366 for the previous year). Taxation requires £457,250, and the net balance is £456,598 (against £526,216), of which £452,192 is attributable to the parent company. It is proposed to pay a final dividend of 10 per cent, making 17½ per cent for the year on doubled capital. The distribution for the previous year was 32½ per cent.

George H. Scholes & Co., Ltd., are paying an interim dividend of 6 per cent (unchanged).

Liquidations

Wad Medani Light & Power Co., Ltd., and the **Sudan Light & Power Co., Ltd.**—Winding up voluntarily. Liquidators, Mr. A. G. Yousif and Mr. G. E. Fowle, both of Central Electricity and Water Administration, P.O. Box 1380, Khartoum, Sudan, appointed 31st March.

We are informed that the operation of the public services, both electricity and water, previously carried on by these two companies was taken over on 1st April by the Sudan Government Department, the Central Electricity and Water Administration, with area offices in Khartoum and Wad Medani. The new administration will accept responsibility for all orders placed by the two companies and the Power & Traction Finance Co., Ltd., is continuing to act as purchasing agents in this country.

London Battery & Cable Co., Ltd.—Meeting of members on 13th May at Liverpool House, 15-17, Eldon Street, London, E.C.2, to receive an account of the winding-up by the liquidator, Mr. T. G. Threlford.

Bankruptcies

H. C. Kinsley, formerly carrying on business as an electrical engineer and contractor under the style of North Lincs. Electrical Installations from 20, Waterloo Street, and 42, Queen Street, formerly residing and carrying on business under the same style and under the style of the Race Course Filling Station from 74, Willingham Road, all in Market Rasen, Lincs. —Trustee, Mr. E. S. Stimpson, 27, Regent Street, Park Row, Nottingham, Official Receiver, released 7th April.

L. Peel, of and lately carrying on business at 216, Low Lane, Horsforth, near Leeds, electrical engineer.—Receiving order dated 28th April, 1953, rescinded, order of adjudication dated 1st May, 1953, annulled, and petition dated 21st March, 1953, dismissed, on 6th March last, it appearing that sufficient moneys have been realised by the Official Receiver to provide for the payment in full of all known debts in the bankruptcy, together with statutory interest of 4 per cent, and the fees and costs of and incidental to the proceedings.

E. V. Williams, 5, Clevedon Passage, Stoke Newington, London, N.16, electrician.—Order made 10th March granting bankrupt's discharge as from 10th April last.

F. Monk, Ashby Road, Stapleton, Leics., electrical and radio engineer.—Last day for receiving proofs for dividend 30th April. Trustee, Mr. W. W. Jordan, 27, Regent Street, Park Row, Nottingham, Official Receiver.

M. Neidle, lately trading at 26, Elmer Gardens, Edgware, Middx., as an electrical contractor.—Application for discharge to be heard on 8th May at Bankruptcy Buildings, Carey Street, London, W.C.2.

Parliamentary Report

Electrical Imports and Exports

Imports of electrical machinery, apparatus and appliances into the United Kingdom have grown considerably since pre-war years and in 1958 reached a total of £29·6 million, as compared with £3·5 million in 1938. This was stated by the President of the Board of Trade, Sir David Eccles, when he was questioned in the House of Commons last week. He issued a table showing the chief supplying countries in 1958 (see *Electrical Review*, 6th February, page 265) and giving comparative figures for 1938.

Mr. Reader Harris, who asked the Minister about imports, was also interested in exports. He wanted to know why the Government maintained the common embargo prohibition on the export to Communist countries of oscilloscopes, cathode ray tubes and the special parts containing, or designed for the use of, one or more cathode ray tubes having three or more electron guns or three or more cathode ray tubes. When he was informed that this was because the instruments had applications for military research, he asked how it was that the apparatus could be exported with only one or two cathode ray tubes; any of these could be sent and could be put together on the other side. Was this not absurd?

Sir David said he was grateful to Mr. Harris for drawing attention to the matter. It would enable the Board to tighten up the controls.

Asked if he had any further statement to make regarding efforts to set aside engineering and power plant contracts obtained by British firms in the United States, Sir David said he had not but the Government had made clear to the United States Government their concern about this matter. There was no danger, so far as he knew, of the T.V.A. contract with C. A. Parsons being set aside.

Radiological Protection

Asked by Mr. Robens when he expected the report, or interim report, of the Veale Committee set up to advise on training in radiological protection to be completed, the Prime Minister, Mr. Macmillan, in a written reply, said the Committee had made two interim reports on specific aspects of their work, and the Atomic Energy Authority intended to make an announcement about them soon. The final report was not expected until later this year. He understood that it was the Authority's intention to publish it, after consultation with the appropriate Government Departments.

Finances of Nationalised Industries

Mr. Heathcoat Amory, Chancellor of the Exchequer, declined to set up a committee to inquire into the comparative profitability of the nationalised electricity and gas industries, British European Airways, Cable & Wireless, Ltd., and the Post Office, when asked to do so by Mr. Denis Howell. Mr. Amory said he was not persuaded that such an inquiry would be useful owing to the different nature and responsibilities of the industries, but the financial results of some of these industries were of course subject to review by the Select Committee on Nationalised Industries.

Mr. Maudling, the Paymaster General, also said "No" to a request by Mr. Osborne for a general direction to be given to the Gas and Electricity Councils to cease spending money on advertising their respective services as each had a monopoly and neither could increase its turnover without decreasing that of the other.

Sussex Nuclear Power Station Site

Sir Ian Horobin, Parliamentary Secretary to the Minister of Power, said he understood that the Central Electricity Generating Board proposed to investigate land at Earnley, Sussex, to ascertain whether it was technically suitable for a nuclear power station. If it proved suitable the Board might in due course apply to the Minister for consent to construct a station on the site and then the Minister would consider any representations made to him by interested parties, and if necessary order a public inquiry before deciding whether or not to give his consent.

Adequate Wiring

Mr. Arthur Palmer asked the Minister of Housing and Local Government to draw the attention of the local authorities to the need for installing electric wiring of adequate capacity in all schemes for housing development in order to bring about a greater diversity of appliances and hence assist the improvement of load factor.

Mr. Brooke said in a written reply that the adequacy of electric wiring was one of the matters to be considered by the sub-committee of the Central Housing Advisory Committee at present reviewing housing standards.

National Approvals Scheme

A hope that the British Standards Institution would soon be able to report some progress on a national approvals scheme being made in conjunction with the electrical industry was expressed by the President of the Board of Trade. Discussions within the industry were still continuing, he said. Miss Burton said these discussions had been going on since October, 1957, and asked if it was the Minister's hope that they would be determined within a month or so. Sir David said he hoped so but there seemed to be genuinely difficult technical problems.

Variable-Ratio Torque Convertor

Authors' summary of a paper entitled "An Electromagnetic Variable-Ratio Torque Convertor" by D. O. Bishop, Ph.D., B.Sc.(Eng.), M.I.E.E., and G. S. Brosan, Ph.D., B.Sc.(Eng.), M.I.E.E., which was read before the Utilisation Section of the Institution of Electrical Engineers on 16th April

THERE are various ways in which power can be transmitted from one shaft to another so that the torque and speed ratios can be varied. In general, electrical methods tend to be either bulky or inefficient. Ward-Leonard sets, for instance, will give the efficiency with the disadvantage of larger size, while all induction-type methods of speed control can only be carried out if the losses are tolerable. In the "conduction drive" an attempt has been made to overcome the disadvantages. Two Faraday discs are placed together in a single housing (see Fig. 1). One is driven mechanically and acts as a homopolar generator, since it is rotating in the field of exciting coil 1.

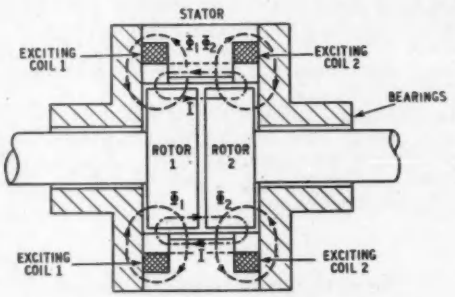


Fig. 1.—Main components of the torque convertor

To keep the m.m.f. of the coil to a tolerably low value the gaps between the rotors and stator are made of the order of 0·015in.

To produce a torque on the second rotor by electrical means, it is necessary to have a current and a flux. Exciting coil 2 provides the flux, while the e.m.f. generated by rotor 1 provides the source of the current. The current path is completed between the two rotors by a copper squirrel cage in the stator and liquid mercury between the rotors and stator. The squirrel cage in the stator is essential since it may be shown that the reaction torque (if any) is taken up by the stator. To prevent undesirable leakage currents, insulation is required on the rotor and stator surfaces as shown in Fig. 2; standard insulating films and varnishes can be used if suitable precautions are taken. The enclosure in which the rotors are housed is made mercury tight by providing suitable standard seals and O-rings.

Simple Theory

If direct currents of I_1 and I_2 amperes flow through the exciting coils 1 and 2, fluxes ϕ_1 and ϕ_2 will be set up as in Fig. 1. If the speed of rotor 1 is N_1 r.p.m. then a voltage

$$V_1 = K\phi_1 N_1$$

will be generated. This will cause a current to flow between the rotors and a torque will be produced on rotor 2; suppose this reaches a speed of N_2 r.p.m. A back e.m.f. will be produced in rotor 2 of magnitude

$$V_2 = K\phi_2 N_2$$

The magnitude of the current between the rotors will then be

$$I = \frac{V_1 - V_2}{R}$$

where R is the resistance of the complete current path. (It is most essential that this resistance should be very low.)

The torques T_1 and T_2 on the rotors will then be related by

$$\frac{T_1}{T_2} = \frac{\phi_1 I}{\phi_2 I} = \frac{\phi_1}{\phi_2}$$

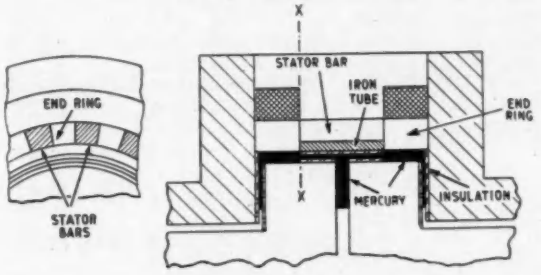
Hence by changing the exciting currents, the fluxes and torque ratio may be altered. This in turn enables the speed ratio to be controlled at will.

Performance and Losses

In performance, the device is rather like a compact, homopolar Ward-Leonard set, since control of torque and speed can most easily be obtained by field control of the generator. Another similarity with the Ward-Leonard set is the possibility of reversal of direction of rotation; this can be done by reversing the current in either of the exciting coils. The speed response of an experimental model to exciting current changes was good, smooth variation being achieved over a wide range. The machine can be arranged to give rapid reversals of rotation without commutation difficulties inherent in other methods.

There is armature reaction in the conduction drive, exactly as in other rotating electrical machinery. The path of the current I is a single-turn toroid and it sets up an m.m.f. in a circumferential direction. In effect, the m.m.f. acts in spatial quadrature to the m.m.f. of the exciting coils. It does not, therefore, influence the generated e.m.f. directly, but it does do so indirectly on account of saturation. The effect of armature reaction can be reduced considerably by inserting in the rotors some non-magnetic bars, which increase the reluctance

Fig. 2.—Constructional details



of the path many times. Such a precaution is unnecessary in the stator, where the equivalent function is performed by the copper squirrel cage.

An unexpectedly large mechanical loss was observed to take place in the mercury, since it is rotating under the combined effect of two sets of forces. One set is the normal hydro-dynamic forces, while the other is the electromagnetic forces which act on the mercury as a conducting fluid. The two sets of forces tend to oppose each other in some parts of the gap, and also act differently in different parts of the gap. There are two results: one is to reduce the effective gap length and thus increase the viscosity loss, while the other is to produce undesirable turbulence. The problem of reducing these losses is being investigated theoretically and experimentally, an improved form of construction having been adopted.

Typical performance figures were as follows:—E.m.f. was 0·7 V at 1,500 r.p.m. Maximum overall efficiency was 45 per cent with an output of 3·1 h.p. and an input speed of 1,000 r.p.m. and an output speed of 700 r.p.m. For this test the I^2R loss was 1·6 kW, iron losses 80 W and mechanical losses (including loss in mercury) 1·1 kW. The resistance of the main current circuit was estimated to be 4 microhms and the current was of the order of 20,000 A.

DISCUSSION

Dr. W. J. Gibbs (British Thomson-Houston Co., Ltd.) said that the authors seemed to think that their convertor could be made satisfactorily for large torques and powers but he had some doubt about this, although he could produce no evidence. They should now not only try to perfect their device but should work out a satisfactory theory. This would help them to get their losses down. He suggested that the authors might also look at the wave impedance concept.

Mr. C. J. Carpenter (Imperial College) remarked that the authors had made a beautifully simple and compact device, but he wondered how much the reduction in size was due to the homopolar arrangement. The rotor winding made for simplicity but it might also make for heavy copper loss. After dealing at some length, with the aid of diagrams, with the induced electric field, he concluded by questioning whether the wave impedance concept to which Dr. Gibbs had referred was applicable. Wave impedance was essentially heteropolar and occurred where there was a travelling wave. In this type of machine, he said, there was flux everywhere but no wavelength.

Mr. A. S. Fenemore (Nelson Research Laboratories) referred to engineering aspects of the device. He thought the great advantage of the scheme was its compactness. The efficiency of the model, 45 per cent, was disappointing. Large losses would be involved and they would present a cooling problem unless the device was force ventilated. The reversal time of six seconds was not impressive, because d.c. reversing wheel motors were expected to reverse from base speed in one direction to base speed in another in about two seconds.

Mr. J. G. W. West thought the authors had produced a splendid idea. With the high currents involved the machine might almost be called an educated short circuit. He stressed the importance of copper for the current circuit in the rotor and put forward a suggestion for overcoming the problem of large magneto-hydrodynamic losses in the mercury.

Dr. Brosan briefly replied to the points raised in the discussion.

Engineering and Marine Exhibition

THE official opening of the Engineering, Marine, Welding and Nuclear Energy Exhibition by Sir Edward W. Thompson, president of the British Engineers' Association, took place on Thursday, 16th April. In his opening address, Sir Edward said that the British engineering industry, in which one out of every seven employed persons in this country was engaged, had more than kept pace with the rapid expansion of industry throughout the world.

Dealing with the various branches of engineering mentioned in the Exhibition title, he referred to shipbuilding, the latest figures for which showed that more than 22 per cent of the world's new tonnage was now under construction in United Kingdom shipyards; and nuclear power, from which it was expected to have an output of 6,000 MW by 1966. He then spoke of the spectacular advances in welding technology which had been made during the past two years, including the development of multi-head automatic welding machines and the high quality welding of both new and conventional materials for atomic reactors. He went on to speak of education, referring to the fact that 90 per cent of the apprentices employed in engineering firms in Britain were given facilities to continue their technical studies during the firms' normal working hours, and the growth in the contribution that engineering exports made to the country's overseas earnings, today being some 40 per cent of the total.

The Exhibition, a description of which was published in our last week's issue, is being held at Olympia, London, and will remain open until 30th April. Altogether about 500 exhibitors are taking part and the displays cover an area of more than 250,000 sq ft.

Negotiations with Europe

IN discussing the future of economic and political relations between the Common Market and Britain and the other members of the O.E.E.C. it is essential to understand clearly the reasons for the present disquieting situation. This is now made easier by a revealing P.E.P. pamphlet* in which Miriam Camps of Princeton University traces the course of the free trade area negotiations and analyses why they failed. She believes that a fruitful outcome is unlikely until there is more fundamental agreement among the principal countries on the objectives of an association. This leads her to the conclusion that there would be more chance of success if negotiations on a long term arrangement were deferred for a few years. If the Common Market functions well, the Six being stronger and less suspicious might then be willing to accept Britain (and perhaps Scandinavia, Austria and Switzerland) as a member, or to negotiate a modified free trade area.

A more immediate call for Britain to join the Common Market is made in a report published by Federal Union†. Its arguments are based on an examination of British, Commonwealth and Common Market tariffs and lead to the conclusion that if Britain stays out of the Common Market the great bulk of our Commonwealth imports will suffer from our economic weakness. It is suggested that preference on Commonwealth imports should be gradually eliminated but that as a compensating measure the Common Market countries should join with Britain in promoting commodity stabilisation schemes and in expanding technical and financial assistance to the Commonwealth.

* "The Free Trade Area Negotiations," by Miriam Camps, Political and Economic Planning, price 5s.

† "Britain in the Common Market," Federal Union, price 2s 6d.

London Board's Contracts

REPORT ON TRANSACTIONS WITH MAYBRIDGE CO.

IN February last year the *Daily Herald* published an article in which an interview with Mr. L. R. Perkins, manager of the Special Contracting Section of the London Electricity Board, was reported and it was said that the Board had placed contracts with a concern called the Maybridge Construction Co., Ltd., which Mr. Perkins controlled and in which other Board employees had shares. Questions were asked about the article in the House of Commons and as a result the Minister of Power (Lord Mills) asked Messrs. Deloitte, Plender, Griffiths & Co., chartered accountants, to investigate the matter. This firm's report was presented to the Minister last week.

It is noted that during the investigation an employee of the Board alleged to the Southampton Police that employees of the Board had been employed on work which the Maybridge Co. had been instructed to do and for which that company had been paid. The outcome was that the company, two directors and a supervising engineer of the Special Contracting Section were charged with conspiracy against the Board but were found not guilty on all counts.

The Maybridge Co. was formed in August, 1957, with a capital of £500 in 252 "A" shares and 248 "B" shares all of £1 each. All the "A" shares were held by Mr. Perkins who thus acquired control of the company and was entitled to a third of the profits. The holders of the "B" shares included five employees of the London Board, one of whom, Mr. J. R. Bovington, was managing director. Mr. Bovington left the Board's employment in September, 1957. The other director (and secretary) was Mr. J. W. Woolley, retired consulting engineer.

Origin of Special Contracting Section

The Special Contracting Section of the London Electricity Board, which forms part of the Board's Commercial Department, was originally the contracting section of Edmundsons Electricity Corporation, Ltd. Upon nationalisation it was acquired by the British Electricity Authority and subsequently transferred to the London Board. Mr. Perkins was manager of the Section at the time of nationalisation and continued in that capacity until he was suspended from duty in February, 1958. He has since been given an appointment elsewhere in the Board's organisation.

The Section tenders for wiring installations and cable work, mainly at power stations operated by the Central Electricity Generating Board and on Ministry of Works projects. It operates not only in London but elsewhere in the United Kingdom, tendering in competition with other contractors. To a limited extent it can place sub-contracts when its tenders are accepted. It has a manager, seven supervising engineers, about 30 inside staff and 250 outside staff. In the last five years the annual invoiced value of work completed has ranged between £309,754 and £746,459 (it was £539,421 in 1958) and the profit before charging head office expenses and interest on capital from £16,739 to £80,346 (£41,134 in 1958). Details are given in the report of the methods of tendering.

Labour for manual work was sometimes short and the Section has therefore occasionally employed outside sources such as the Maybridge Co. It was this which, according to Mr. Perkins, led to the conception of the company as a means of keeping "rough labour" gangs together and retaining the key personnel in charge of those gangs. Nevertheless the investigators say they do not consider it proper that an employee of the Board in a position to award sub-contracts should have any financial interest in any concern to which contracts are, or may be, awarded.

From the commencement of business until 31st January, 1958, the Section received invoices from the company for work done totalling £7,749 and at the time of the inquiry there were outstanding orders, not invoiced, amounting to about £830. As no accounts have been prepared by the company since it commenced business the investigators cannot say whether it has made either a profit or loss in its transactions with the Section. It seems that the Section allowed in its quotations for a good margin of profit on the labour sub-contracted to the company.

No Payments Received

Mr. Bovington claimed that although the company paid high bonuses to its workmen it was still able to quote relatively low prices to the Board because its overhead expenses were small and by working as teams there was better output from the labour gangs. Mr. Perkins stated that no payments of any kind had been received by him or any other shareholders of the company who were on his staff.

Engineers who had awarded sub-contracts to the company said that in considering whether work by rough gangs should be sub-contracted they considered whether the cost was within that covered by the principal contract and whether the sub-contractor was reliable and efficient. The investigators have seen no evidence that the Board has suffered any actual loss by the award of sub-contracts to the company. In the cases examined the price charged by the company was low enough to give the Board a good margin of profit.

So far as it has been possible to ascertain, none of the directors or proprietors of other companies and firms with which the Section has had substantial dealings were employees of the Section.

Chairman's Interview

Appended to the report is a copy of a report by Mr. D. B. Irving, chairman of the London Electricity Board, to the Minister of Power in which Mr. Irving says that when the *Daily Herald* article appeared he, with others, interviewed Mr. Perkins, who told him that he (Mr. Perkins) had not sought approval to his association with the Maybridge Co. "since he knew that approval would not be given. . . . In his enthusiasm for his work he appeared not to realise the implications arising from his association with such a sub-contractor."

Another appendix is a report by Mr. Perkins to the chairman of the Board in which he dealt with the circumstances leading up to his association with the company and justifying his actions as being in the Board's interest. He emphasised that neither he nor the other shareholders employed by the Board had received payments of any kind from the company.

New Books

Principles of Transistor Circuits: Introduction to the Design of Amplifiers, Receivers and other Circuits. By S. W. Amos, B.Sc.(Hons.), A.M.I.E.E. Published for *Wireless World* by Iliffe & Sons, Ltd. Pp. 167; 105 diagrams. Price 21s.

The development of the transistor is generally regarded by electrical engineers as one of the most notable landmarks of post-war years. Because of its small size, robust nature, low power consumption and small heat dissipation, the transistor has not only replaced the valve in many of its conventional applications but has also opened up new fields in electronics. Applications include miniature radio receivers and audio frequency equipment, including hearing aids; data handling equipment and computers; instrumentation; control circuits, including those for guided missiles; and photo devices.

This book has been written by a member of the Engineering Training Department of the B.B.C. to assist those who require an introduction to the design of transistorised equipment, and it is intended for professional designers, students and amateur constructors. Assuming no previous knowledge of the subject, the first two chapters explain the physical processes occurring in transistors; but subsequently the main emphasis is on the application of these principles to the practical problems of design, and the bulk of the book is concerned with the determination of such quantities as input resistance, stage gain, optimum load, power output, values of coupling capacitors and transformer winding inductances.

A large number of worked examples are included, the mathematics of which is confined to simple algebraic manipulation, and these serve to show the order of the practical magnitude of the various quantities.

General Circuit Theory. By G. Newstead. Pp. 144; figs. Methuen & Co., Ltd., 36, Essex Street, Strand, London, W.C.2. Price 15s.

This work is indicative of the fact that although there exists quite a considerable volume of literature on circuit theory there is still room, and even need, for additions which either break new ground, present the subject in a new guise, or offer a treatment unifying current theories and methods. Professor Newstead's book falls partly within the last two categories for it develops general circuit theory "which can be applied in the many fields in which the concept of a circuit is applicable." As he points out, and as is well known, such fields lie in the sciences and technologies of mechanics, optics, acoustics and economics as well as in electrical engineering, physics and traffic scheduling; "in fact in any application concerned with an operation on an 'input' to obtain an 'output.'" Although the book is written in the language of electric circuit theory the approach is a fundamental one employing the minimum of assumptions so that the results will apply to all the fields where the circuit concept is valid.

The first chapter is introductory and deals with the general structure of circuits, the definitions of their quantities and elements and their inter-relations. The second chapter gives some of the general circuit theorems commonly employed and their particular, and sometimes restricted, applications. The third and fourth chapters deal with linear passive four-terminal circuits in the steady state and in the transient state respectively, and the fifth chapter considers certain extensions of linear circuit theory to non-linearity. A list of references and an index complete the volume.

The work is of an advanced character as befits a monograph and, of course, it contains such mathematics as is appropriate. It may be accepted as a competent and concise presentation of circuit theory fundamentals, but it is rather astonishing that it contains no reference to Cauer's classical work or to the impact of topology on modern circuit theory. The book belongs to the publisher's series, "Monographs on Physical Subjects," of which it is a very worthy member.—A.E.

Principles of Electronics. By H. Buckingham and E. M. Price. 2nd Edition. Pp. 419; figs. 305. Cleaver-Hume Press, Ltd., 31, Wright's Lane, London, W.8. Price 17s 6d.

This book is intended to give a grounding in electronics particularly to students in heavy electrical engineering who nowadays require to use electronic methods. In the second edition the material on the physics of semiconductors has been extended and new chapters on magnetic amplifiers and transistors have been added.

The authors have admirably succeeded in their aims and the book is clear and accurate while preserving an introductory viewpoint. In particular there is a marked absence of misleading or incorrect statements. The treatment is mainly qualitative and no attention is paid to such questions as the calculation of triode μ's, etc. However, the authors devote a reasonable amount of space to the calculation of triode gain, tuned amplifiers and rectifier circuits. Conventional d.c. and a.c. circuit theory is dealt with in other volumes appearing in the same series and is therefore treated as outside the terms of reference of this book. A clear discussion of negative feedback is included.

The book is well printed and is lavishly illustrated with well-chosen illustrations. It should find a ready welcome from a wider circle than the intended readers and is recommended in particular as background reading for sixth-formers specialising in science.—A.H.B.

LETTER TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

13 A Socket Outlets

FURTHER to my letter in your issue of 6th March about 13 A sockets and plugs, I agree with Mr. R. C. K. Money on several of his points, but must disagree with his statement that everyone uses 13 A fuses for all purposes. My television set, reading lamp, refrigerator, toaster, washer, etc., all work from 13 A socket-outlets, but the plugs are fused down accordingly. It is a simple matter to take the plug apart, eject the 13 A fuse and fit a 5 A (or size required) fuse in its place. The trouble is that most householders buy a 13 A plug and think that because it has a fuse fitted it is all right for any job, whereas if they took the trouble to ascertain the amperage of the apparatus they were using and fitted a fuse in the plug to correspond, the safety measure would be greatly increased.

Billinge, near Wigan. STANLEY JOHNSON.

HIGH MARNHAM

First 200 MW Turbo-Alternator Tested

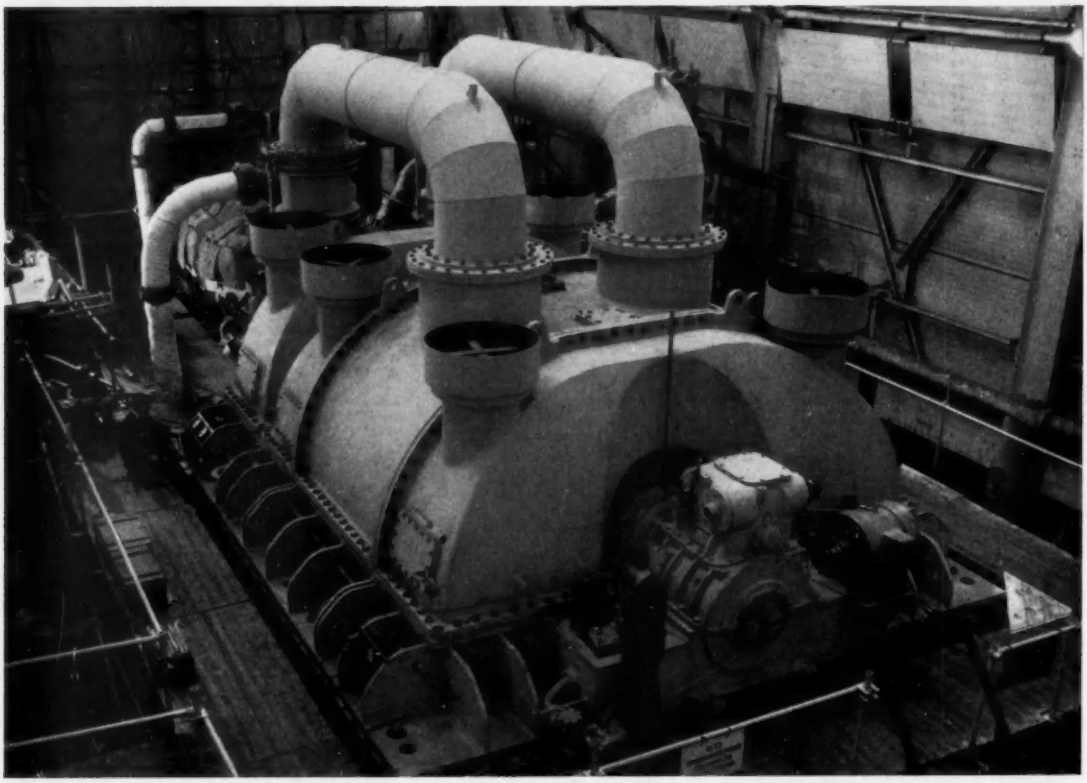
THE first 200 MW, 3,000 r.p.m. English Electric reheat steam turbine for the Central Electricity Generating Board has now successfully undergone works tests preparatory to being installed in High Marnham power station. Detailed descriptions of this station, with graphic illustrations issued as supplements, were given in the *Electrical Review* of 22nd and 29th August, 1958. When completed, the station will contain five 200 MW turbo-alternator sets and will be the largest not only in Britain, but also in Europe. English Electric are also supplying five 415 V switch and control gear units to High Marnham. Delivery of these units has already begun and will continue in phase with the commissioning of the main turbo-alternator sets.

The new turbine is the largest ever to leave the Rugby works of the English Electric Co., Ltd. It is also the first tandem 200 MW steam turbine to be manufactured in Britain. With a running speed of 3,000 r.p.m., the 200 MW steam turbine is of the horizontal three-cylinder design having a double-casing impulse type h.p. cylinder. Steam enters the turbine stop valve at 2,350 p.s.i.g., 1,050 deg F. The steam from the h.p. turbine exhaust is taken to the reheater and then returned to the i.p. cylinder at 475 p.s.i. and 1,000 deg F. The i.p. cylinder is combined with one section of the three-flow l.p. cylinder. Approximately one-third of the steam passes through the combined l.p. portion of the i.p. cylinder and the remaining two-thirds is led through two overhead interconnecting pipes to the double-flow l.p. cylinder. The three-flow l.p. cylinder exhausts to a single-shell condenser, the vacuum at the most economical and continuous maximum rating being 28·7in Hg when using cooling water at 60 deg F.

The alternator is of the latest hydrogen-cooled design employing direct cooling of the stator and rotor conductors at a rated gas pressure of 30 p.s.i. The hydrogen coolers are arranged longitudinally in the upper part of the stator frame and circulation of the hydrogen through the machine and coolers is by means of an axial flow blower. Generation is at 16·5 kV with rated phase current of 7,780 A at 0·9 power factor.

Courses on European Trade

"Consumer Durables in the New European Market" is the title of the tenth in the series of courses organised by Britain and Europe and the Federal Trust for Education and Research on various aspects of the European Economic Community and Britain's relation to it. The course will be held at the Milestone Hotel, London, W.8, from 29th April to 1st May.



The 200 MW turbo-alternator for High Marnham on final test at the English Electric Rugby Works

PLANNED LIGHTING

Adequate Illumination and Conformity with Architecture

THE lighting of new premises or the re-lighting of existing premises enables the architect and the lighting engineer to jointly prepare schemes which will not only ensure adequate lighting but also that the installation will conform to the architectural features of the premises. In the following notes brief particulars are given of installations in which this combination has resulted in illumination which meets both these requirements.

In Liverpool Cathedral a specially designed G.E.C. lighting system was installed to provide extra illumination for concerts of sacred music, and this has proved so successful that it has been retained as a permanent installation for general use. The installation consists of ten "Gecoray" reflectors mounted at triforium level and housing 500 W "Osram" lamps, supplemented by fluorescent lighting above the choir stalls. The system was installed by H. C. Woolliscroft & Co., Ltd., Liverpool.

A colourful example of planned theatre lighting can be seen at the Ritz Cinema, Gosport, which was recently redesigned and re-built after war damage. The auditorium design shows a refreshing approach by the architects, Messrs. Douglas Cogswell and Partners, the conventional patterns of ceiling coves having been discarded in favour of a flat ceiling, formed of fibrous plaster and divided into 6ft square modules. Ten of these modules are used as lighting panels, four 5ft 80 W Atlas "white" tubes (Atlas Lighting, Ltd.) recessed into square panels in the module providing soft, indirect illumination. For the under-balcony area, six "Atlas" fluorescent fittings are used. As recessing was not practicable, these have been decorated with fibrous plaster to merge into the ceiling line. Front-of-house illumination is provided by fluorescent tubes mounted behind the coves of the proscenium arch to give pleasant, indirect light. Tricolour fluorescent footlights and battens in front of the house curtains contain pink, blue and green tubes for colour change lighting, and are controlled by an "Atlas" electronic dimmer board at the side of the stage. Fluorescent fittings are also used in the upper and lower foyer, the offices and the canopy. The electrical installation was carried out by G. Hamilton-Cole, of Southsea.

Special Suspension Brackets

An interesting lighting installation has recently been completed in the main offices of the Clerical, Medical and General Life Assurance Society, in St. James's Square, London. The original scheme consisted of single-lamp 80 W fluorescent fittings with glass side screens and control gear mounted at the ends, giving an average illumination of less than 8 foot-candles; it was installed soon after the end of the war. It was decided to use Harris & Sheldon individual 5ft 80 W twin "Luveline" fittings, but in order to avoid damage to the fine plaster ceiling, they were hung from the same suspensions as the original fittings. These were at 5ft centres, necessitating the manufacture of special suspension brackets on the "Luveline" fittings. The illumination is now of the order of 30 foot-candles.

The lighting at the recently opened new operating theatre at Dulwich Hospital was carried out by Troughton & Young (Lighting), Ltd. Unusual features include some semi-recessed 1,000 W lamps. The operating theatre lamp is, however, of German origin. Lighting in other areas includes ceiling and surface fittings, which are connected to the emergency supply.

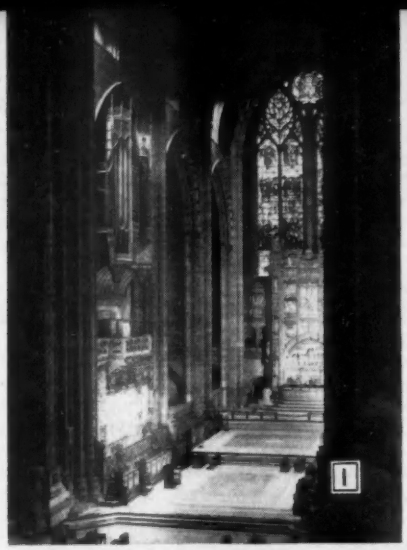
Decca House, Albert Embankment, London, the headquarters of the Decca Group, comprises ten floors and a basement providing 60,000 sq ft of office space. The lighting fittings, with the exception of the directors' suite, were supplied by Crompton Parkinson, Ltd., to the requirements of the architects, Messrs. Grace & Farmer, and in the main are of the "New Range" fluorescent type, with some tungsten fittings in special positions. Lighting in the main entrance hall is provided by two decorative recessed louvred fittings each with four 80 W, 4ft daylight fluorescent tubes. Concealed fluorescent lighting illuminates the two lifts serving this entrance and reception area. The canteen, luncheon club and kitchens take up the whole of the eighth floor and with the exception of the serving area, "New Range" fluorescent fittings are installed. The kitchens use 5ft vapour-proof fluorescent fittings with "Perspex" tubes completely enclosing the lamp. The canteen and the luncheon club-room for the senior staff have twin lamp fluorescent fittings. General office and corridor lighting is provided by fluorescent fittings with 2ft, 4ft or 5ft tube lengths, as required, with similar "New Range" diffusers. A high level of light is thrown on to the ceiling and upper walls and an even level of illumination averaging 40 lumens per sq ft is provided in working areas. The electrical sub-contractors for Decca House were W. J. Furse (London), Ltd., and the consulting engineers were Taylor Woodrow Construction, Ltd.

To improve existing office accommodation and to allow for further expansion, the London office of the Bank of West Africa in Gracechurch Street has been reorganised on its three main floors. On the ground floor a suspended acoustic ceiling has been fixed and a Holophane recessed fluorescent system of optical louvres installed to provide an average of 40 lumens/sq ft with two 80 W MCF/U lamps in each fitting. Pendant "Holoflux" fluorescent units are also suspended over the counters and because of the comparatively low mounting heights at these points a general service illumination of 75-80 lumens/sq ft is provided. This high intensity is found acceptable as the special cone prisms in the units provide an effective cut-off without discomfort glare from the tubular sources. Architects for the alterations were Messrs. Ronald Ward & Partners, and the electrical contractors were Johnson, Pearce & Co., Ltd.

The new premises of Lloyds Bank, Bond Street, London, are an excellent example of designed lighting, and the result of architect-illuminating engineer co-operation. Illumination is by "Ekco" modular recessed fluorescent fittings and specially designed curved cornices.

An unusually large fluorescent lighting installation is that of the Caterpillar Tractor Co., Ltd., Tannochside, Glasgow, for which the A.E.I. Lamp & Lighting Co., Ltd., has provided 6½ miles of lighting trunking—22,600ft of "Mazda" universal trunking, 11,600ft of A.E.I. shallow trunking, and 1,500ft of A.E.I. "Invertrunking"—and 4,750 fluorescent lamps, 4,320 of which are 8ft 125 W lamps. For emergency lighting purposes, it is customary to use tungsten filament lighting, but in this scheme the engineers have departed from the normal, and introduced a fluorescent emergency lighting scheme. A variety of tungsten and fluorescent fittings, some of special design, are used in the entrance hall, assembly hall, cafeteria and kitchen. The A.E.I. Lamp & Lighting Co.'s engineers worked in close co-operation with the consulting engineers, Messrs. Strain & Robertson, of Glasgow, who designed the scheme, and James Scott & Co., Glasgow, who carried out the electrical installation.

1. Liverpool Cathedral (G.E.C.). 2. Ritz Cinema, Gosport (Atlas Lighting, Ltd.). 3. Clerical, Medical and General Life Assurance Society, St. James's Square, London (Harris & Sheldon). 4. Operating theatre, Dulwich Hospital (Troughton & Young (Lighting), Ltd.). 5. Kitchen at Decca House, Albert Embankment, London (Crompton Parkinson). 6. Bank of West Africa, Gracechurch Street, London (Holophane). 7. Lloyds Bank, Bond Street, London (Ekco-Ensign Electric, Ltd.). 8. Caterpillar Tractor Co., Ltd., Tannochside, Glasgow (A.E.I. Lamp & Lighting Co.)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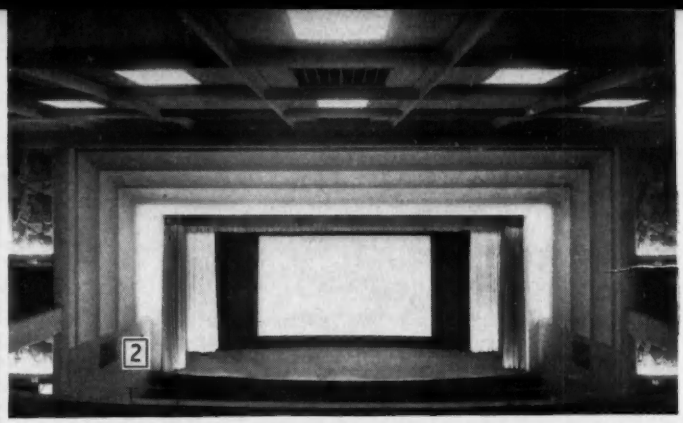
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Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

IN the thermal calculations associated with electrical machines there are a certain number of secondary problems which, taken individually, will not affect the overall result of the calculations to any great extent. However, the total effect of all these partial problems on the thermal characteristics of the machine may be quite considerable, so they must be investigated and, at the very least, their effect has to be taken care of by suitable correction factors.

One of the more important secondary problems is the heat transfer and resistance on the heat-exchange surfaces between parts of unilaterally heated cooling ducts. The method presented is based on a constant heat transfer coefficient and on turbulent flow of the air in ducts comparatively short when compared with their hydraulic diameter. The theory is based on the case of a bar with heat supply at one end and without heat withdrawal at the opposite end, but only on two long sides of the bar. It is then used to consider a unilaterally heated duct without resistance to transfer and eventually a resistance to transfer is introduced. Experimental determination of the heat transfer coefficient from measured surface temperatures, and of the resistance to transfer, introduce worked examples of applications of the method presented. —"Unilaterally Heated Ducts in Electric Machines," J. Hak, *Arch. Elektrotech.* (Berlin), Vol. 44, No. 2, pp. 107-116, 1959, in German.

Direct Cooling of Conductors

Conductors are said to be directly cooled if heat is transferred to the coolant without, as far as possible, passing through solid bodies between conductor and coolant. In generators the h.v. insulation has a particularly high thermal resistance and, if the current heat is passed through the iron, the latter has also an additional resistance to heat flow. The removal of these barriers to the flow results in increased density of the thermal flow as compared with conventional cooling methods. Direct cooling of the conductors simplifies the calculation of the temperature distribution also, because it is possible to neglect the passage of heat through the insulation of the stator winding compared with the heat flow to the coolant in intimate contact with the conductor.

In the rotor, where the thermal resistance of the slot insulation is considerably smaller, the flow of the rotor surface may be important, especially if the cooling in the air gap is intensive. With direct conductor cooling the temperature distribution can generally be calculated from the flow of the coolant, its thermal capacitance, the heat exchange coefficient and boundary conditions. In large generators forced circulation of the gaseous or liquid coolant is used. The frictional resistances to this type of flow were determined and found to agree with those for flow through pipes. This enables the flow velocities in the ducts to be determined. The heat exchange coefficients can then also be determined with sufficient accuracy by Nusselt's power formulæ. It is then possible to find the temperature distribution in conductors and coolant.—"Steady Temperature Distribution when the Conductors have Direct Cooling," H. Weh, *Arch. Elektrotech.*, Vol. 44, No. 1, pp. 32-46, 1958, in German.

Saturable Reactors

The fact that saturable reactors are three times re-magnetised during the pause of the phase current, may under certain conditions be troublesome when the rectifier works as an invertor. Normally, the reactors will only reduce the extinction angle (say, from 60 to 55 deg), which is not dangerous for the normal operation of the plant. When the invertor operation is continuous, i.e. a deliberate reversal of the system operation, and the extinction angles are small, reactors of type rating 0·05 to 0·06 will retard the commutation inception to 7 to 9 deg, which reduces the extinction angle to zero and causes reversal of the invertor.

An adjustment of the setting of the compounding device by a definite value will in this case keep the extinction angle constant (at 10 to 15 deg). However, even in this case the presence of saturable reactors will involve additional losses and slightly reduce the p.f., owing to the value of the inductance of the saturated reactors. It is therefore recommended to have saturable reactors shunted in rectifier plant operating as invertors with small extinction angles, unless there are strong reasons to keep them in operation for using their faculty of preventing sudden drops of the anode voltage at the instant of valve extinction.—"Operation of Saturable Reactors in Convertor Installations of a D.C. Transmission System under Regulation and Reversal," F. I. Kovalev, G. P. Mostkova, *Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk*, No. 12, pp. 32-37, 1958, in Russian.

Arcs in Longitudinal Slots

The first of the authors, well known for his work in this field and for his book on the electric arc in switchgear, has extended his investigations on arcs in narrow slots between long electrodes and moved by a magnetic field. The measurements of the speed of the arc were carried out by a probe method using an electrodynamic oscillograph the loops of which were connected to individual probes. The passage of the arc through the probes enabled the speed of the arc to be determined quite accurately, and the oscillograms also showed arc current and arc probe voltages. The arc speeds went up to 200 m/sec (in most modern arc-quenching chambers with slots, arc chutes and de-ion grids they do not exceed 100 m/sec), therefore the range investigated definitely covers all the cases of practical interest.

The results obtained could all be represented very well by analytical expressions which in limiting cases turn into the "classic" formulæ of the volt-ampere characteristics of the arc. The experiments were further extended to include slots with ribs and lateral openings and closed recesses and extensions. These increase the arc voltage, obviously by increasing the longitudinal gradient in the recessed sections. This, in turn, is due to the more thorough cooling of the arc in these sections. The investigation therefore clearly shows the advantage of having ribbed or recessed slots in arc-quenching chambers. —"The Electric Arc in Longitudinal Slots," O. B. Bron and L. A. Rodshtein, *Elektrichestvo*, No. 12, pp. 14-18, 1958, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Sales and Development

SUMMARY OF PAPERS PRESENTED AT E.D.A. CONFERENCE

THE 22nd annual conference of the British Electrical Development Association was opened on Tuesday at Caxton Hall, London, and continues until today (Friday) when the proceedings will be concluded at the Connaught Rooms, W.C.2, with a general discussion, a closing address by Sir Josiah Eccles (deputy chairman of the Electricity Council) and the conference luncheon.

The opening address on Tuesday morning was given by Mr. W. N. C. Clinch (controller of the Eastern Division of the Central Electricity Generating Board and chairman of the E.D.A. Council) after which Mr. J. I. Bernard (director and secretary of the E.D.A.) reviewed the Association's activities in 1958-59 and outlined the advertising campaigns arranged for 1959-60.

Organisation of a Contracting Section

At the afternoon session, when Mr. T. E. Daniel (chairman, North Western Electricity Board) presided, a paper on " The Organisation of a Contracting Section " was presented by Mr. J. Dunwoody (assistant chief commercial officer, London Electricity Board). This was a factual account of procedure and included specimens of the various forms required for the day-to-day work of the section, such as consumer's inquiry, " doorstep " quotation, detailed estimate, stores requisition, etc. A flow diagram illustrated the range of operations involved from the time an inquiry or request for service was received until the account was rendered, and typical staffing arrangements for a section office were also set out.

The main parts of the paper dealt with procedure and methods; estimating and the submission of estimates; acceptance of quotations and the issue of job instructions; control of inquiries; job instructions; the contracting section office; depot organisation and the supervision of work in progress; stores and requisitioning of materials; costing and invoicing; and overhead charges. On the last subject, it was pointed out that while the results of action taken to reduce direct charges could be seen, economies in overhead charges might not be so easily observed. To arrive at the correct percentage to cover overheads, the actual proportions of time spent by technical and clerical staff on duties concerned with contracting work that was directly chargeable to consumers had to be established. Development staff were called upon to advise consumers on matters concerning their wiring installation and equipment as part of their normal duties and in many instances the submission of an estimate was an ancillary task. Differing percentages might be added to the labour and materials components of direct costs to recover overheads, but in the case of transactions up to £50 in value a single percentage figure for overheads and profit was to be recommended.

Overheads were inescapable and their reduction below a certain level might well impair the efficiency of the whole organisation, but until this point was reached room for improvement would exist. Procedure and methods must, therefore, be periodically reviewed and where necessary revised to meet changing conditions.

All-Electric Flats

On Wednesday morning, when Mr. R. R. B. Brown (chairman, Southern Electricity Board) presided, a paper prepared by Mr. J. W. Moule (chief commercial officer, South of Scotland Electricity Board) was presented dealing with the electrical installations in multi-storey blocks of all-electric flats. The increasing interest shown in large blocks of flats, he said, had been brought about by several factors, among them being the rebuilding of slum and bomb damaged areas in congested cities, the necessity to make the maximum use of those building sites that were available, the fact that the Exchequer subsidy for multi-storey buildings was greater than that for two-storey dwellings, and the demand for such amenities as central heating which could more easily be provided in flats. In consequence, blocks twenty or more storeys high were being constructed, and at this height conventional central heating required less capital expenditure than individual solid fuel grates, while the still lower capital cost of electrical floor heating justified its use, even in three-storey blocks.

The first blocks to be built using electrical floor warming were, he believed, three-storey blocks at Inverness, although at that time an off-peak tariff was not being offered in that area, and he outlined the growth of all-electric flats which had resulted from the successful operation of these and subsequent blocks and the favourable reaction of the tenants. Off-peak electrical floor warming had undoubtedly taken its place as the future pattern for multi-storey blocks of flats, and at present in Southern Scotland 3,000 local authority owned dwellings without fireplaces or gas supplies had been built, were under construction or had been planned.

Details of electrical installations and operating costs were dealt with in later sections of the paper. The distribution of supplies within a block, particularly as the system must be duplicated to take advantage of an off-peak tariff, was intricate and costly. The incoming supply might be separated at the main supply point to the building, requiring a duplicate system throughout, or at each floor, needing contactors and two sets of laterals at each floor, or with a contactor at each flat. In local authority flats, floor warming was usually provided in the living room and the hall, with the kitchen and part of the bathroom sometimes included, to give a 60 deg F air temperature, and a 2 kW fire was supplied for use during extremely cold weather. Individual water heaters were usually provided in each flat, with hot water storage varying from 15 to 30 gal, and immersion heaters of 3 kW loading seemed to be almost universal, with little or no evidence of scaling. Approximately 45 per cent of these operated on normal supply. It was felt that the slight saving by using an off-peak tariff was offset by the risk of being without hot water when it was required, though little trouble from this cause seemed to have occurred as yet.

Wash boilers and, in some instances, clothes drying cupboards, were provided in individual flats, though communal laundries, fitted with washing machines, hydro-extractors and dryers, and used by the tenants on a rota system, were being increasingly provided. The cost to the tenants of this facility varied from 1s 9d in prepayment meters for an average four-person weekly wash, to a fixed amount of 3s included in the rent.

After dealing with other electrical equipment installed,

including cookers, garbage incinerators, and socket outlets, Mr. Moule discussed the desirability of an advisory service to assist the tenant to gain the maximum advantage from the installation, and the payment of accounts, concluding with some actual costs, which varied from 19s 4d down to 10s 5d per flat per week.

Commercial Catering

In the afternoon a paper on "Selling Commercial Catering" was presented by Mr. W. J. Guscott (assistant chief commercial officer, South Western Electricity Board). Mr. H. V. Pugh (chairman, Eastern Electricity Board) presided.

Mr. Guscott said that only a small part of the catering equipment now in use had been sold and installed by the electricity supply industry and private electrical contractors as a result of direct sales promotion. A large measure of such success as had been achieved could be attributed to the manufacturers, working against heavy odds, selling their equipment in the field and maintaining it in service. With the exception of motor driven equipment, progress was not very striking, and electricity had barely touched the fringe of one of the largest industries in the country. After suggesting the reasons for this, he went on to outline the scope for development. There must be, he said, some 300,000 catering establishments in the United Kingdom, and of the total equipment in use he doubted if the electrical industry could claim as much as 15 per cent. The amount of electrical equipment used to produce heat for cooking was probably only 5 to 8 per cent.

If 50 per cent of the commercial cooking equipment (excluding machinery and refrigerators) now in use was converted to electricity over a period of ten years, the sales of equipment plus wiring and installation work would be worth £8 million a year to the Electricity Boards and the increase in sales of electricity at the end of the period would have probably reached 2,000 million kWh a year. The supply industry could also attract a further £1 million a year by regular maintenance contracts. Taking into consideration the factors such as the Clean Food Act which favoured electricity, Mr. Guscott did not think this target of 50 per cent all-electric cooking in ten years was over-ambitious. It would require a selling force of about 420 to 460 and each sales representative would have to make sales contact with about thirteen establishments a working week.

Because of the low discount on commercial catering equipment, Boards must at present judge the success of their efforts not by trading profit but by the load-building value of the equipment sold and the sales of electricity. To enlist more help from the Boards, Mr. Guscott suggested that manufacturers should increase their discounts even if this meant having to raise slightly retail prices to the catering trade. In the final sections of his paper Mr. Guscott discussed at some length the planning of a full-scale selling organisation, publicity and sales techniques. Among his recommendations were that E.D.A., the manufacturers and Boards should co-operate in increased Press advertising under a common slogan, and that Boards should undertake regular maintenance on a contract basis.

Clean Air Act

Mr. W. R. T. Skinner (deputy chairman, South Eastern Electricity Board) presided at Thursday morning's session when Mr. P. Honey (E.D.A.) presented a paper on "The Clean Air Act, 1956."

Mr. Honey commenced by giving a résumé of the Act and the various explanatory memoranda published by the Ministry of Housing and Local Government. He then dealt with the competitive publicity literature issued by the electricity, gas and solid fuel industries, and the various forms of atmospheric pollution. Examining the present position of the main smokeless fuels, Mr. Honey said that with the yearly increase in plant installed in C.E.G.B. power stations and 20,000 MW of maximum demand having been successfully met by the grid during the past winter, one might hazard a guess that the electrical industry was in a position to meet any increased load due to conversions from coal heating and water heating to electricity. When considered in terms of individual Smoke Control Areas this was not alarming. A typical Order, for example, might cover 2,000 houses and if electricity obtained its fair share of one-third of the business, putting in 2 kW inset fires in place of coal-fired grates, the increase in maximum demand might reach 800 kW in that area. There would be no nation-wide shortages of power station fuel in the foreseeable future, even if other industries found ways of turning low-grade coal into gas or processed smokeless fuel.

Tremendous changes had taken place in the overall scene during the past ten years. The fuel situation was rapidly changing as each fuel industry strove to stake its claim for supplying smokeless heat to the consumer and made its plans for future expansion. Competition between fuels would no doubt increase in the coming years and the electricity supply industry could not afford to be complacent. Running cost might no longer be a deciding factor. Convenience, cleanliness and safety might well be the reasons why electricity should be chosen, even if it was outpriced as far as net fuel costs were concerned. These factors, together with low costs of installation, would have to be weighed and considered by the public in the days to come. It was the industry's boast that electricity consumption doubled every ten years but there was no guarantee that it would continue to do so. Much remained to be done to maintain this record and to increase it if possible by selling more current off peak, particularly to keep all the new nuclear power stations fully loaded at all times.

Industrial Development

The results of scientific research towards higher productivity are not being adopted quickly and readily enough by British industry. This was the basis of the paper on "Industrial Development" by L. Landon Goodman (E.D.A.) read at the Thursday afternoon session at which Mr. T. M. Ayres (chairman, North Eastern Electricity Board) presided. There might be several reasons for this state of affairs: the comparatively small number of engineers and scientists employed in industry, the relative paucity of production research and development whether measured in time, effort or money, the degree of technical illiteracy, and the insufficient emphasis which was given to management training and development.

There was much to be done in industry. In car manufacture not more than about 6 or 7 per cent of the operations performed today could be considered to be automatic. The scope for increasing the industrial electrical load was tremendous. Electricity offered users some wonderful opportunities to improve or to introduce revolutionary production methods. New electrical methods were being continually introduced in all fields of application.

Electronics in one form or another entered into nearly all types of electrical applications, either providing a unique method of working, such as high-frequency heating, or operating in conjunction with equipment of

traditional form as in the case of electronic speed control of electric motors. The paper then described some new industrial developments not all of which were being used extensively today but which, in many cases, could be, and indeed should be. There was scope for improved lighting in virtually every factory. A modern trend in lighting was towards higher levels of illumination. Another advance was the provision of an ample upward light component to meet the psychological need of permanent artificial lighting in a building. One example of new methods of electrical processing of materials was the "top-hat" kiln used in the pottery industry (see *Electrical Review*, 19th December, 1958). Electric infra-red paint stoving of car bodies had further increased production, with reduced floor space, while one of the more important applications of electro-heat had been the extension of the use of arc furnaces into the field of large-scale steel production, including plain carbon steel. The mains frequency coreless induction furnace was now being used for the melting of high-speed steel and cast-iron swarf. It offered an appreciable reduction in capital cost and increased operating efficiency due to the absence of generator losses.

Motive power was one of the vital links in most automated processes and here the electric motor had many important advantages to offer. There was a gap in the range of electrical equipment which needed filling quickly —we had no linear power device which was compact, fast in operation, cheap, and available in all sizes and which would compare favourably with the pneumatic and hydraulic thrustor.

Industrial television was at the pioneering stage, but already it was used quite considerably in a variety of industries where close inspection was not safe or possible or where a number of differently situated operations could be better controlled from one point.

Each year plants became more complex and more and more process variables had to be measured. The necessity for checking a large number of measured and controlled values made some form of data reduction necessary and automatic scanning desirable. The Northfleet power station would be the first station in the United Kingdom to use automatic logging and data-reduction equipment for plant supervision. The equipment would automatically and continuously scan and record at a very high speed the readings of the instruments measuring flows, levels, pressures and temperatures of the boiler, furnace and turbine units. The system would print out the relevant data at regular intervals, recording and giving warning of any deviations from normal in the readings. It would also compute and record continuously the overall boiler efficiency.

The computer was ten to fifteen years old and for the first eight or ten years it had been mainly used for scientific and engineering purposes, but now specially designed data systems were being used for particular commercial applications such as accounting, inventory and production control, and banking.

SCOTTISH BOARD'S ELECTRICITY CHARGES

APPEALS by the South of Scotland Electricity Board against decisions by the Court of Session, Scotland, that actions by the British Oxygen Co. and British Oxygen Gases, Ltd., should go to trial have been dismissed by the House of Lords. The British Oxygen Co. had sought a declaration that the Board had exercised "undue discrimination" against high-voltage consumers in that the Board's fuel-variation clause failed to take account of the fact that h.v. supplies cost the Board less than l.v. supplies. The repayment of £10,000 alleged to have been overpaid was also claimed by the company. In a similar action by British Oxygen Gases, Ltd., it was also said that the Board had exercised discrimination by its failure to incorporate in its tariff an annual maximum demand charge, based on a figure of ten times the maximum monthly demand charge, for consumers with a load factor of over 70 per cent.

The Board's case was that since h.v. users were in fact charged less than l.v. users, there could be no discrimination, and that in any event there was no right to repayment of alleged overcharges.

After saying that he could see no justification for the Board's reply on the first point, the Lord Chancellor (as reported in the *Financial Times*) added that he saw no reason why the companies should not be allowed an opportunity of proving that the figure they put forward was the lowest proper differential to be adopted. The Board should not be permitted to retain sums for which they had no warrant to charge. It was within the competence of the Court after hearing evidence to estimate the amount of the overcharge. In the second case the company had put forward a case which required that the facts should be ascertained before a final answer was given as to its relevancy. He would dismiss both appeals; Lord Merriman and Lord Tucker concurred.

Lord Reid said that, while he did not think a person paying less than another could be said to be discriminated against, he would not dissent from the majority view that a proof should be allowed in the first case. In the second case, however, the company was saying the Board were bound to make a different form of tariff which would enable a consumer having a high load factor to escape more lightly. That was a very different thing and he would allow the appeal to the extent of holding irrelevant the averments made in support of that claim. Lord Keith also agreed that the appeals failed except in regard to the averments in support of a demand for an annual maximum demand charge.

Whitworth Fellowships

THE Minister of Education, Mr. Geoffrey Lloyd, has decided to double the value of the Whitworth Fellowship and alter the rules so that the award in future will be given to practising engineers.

From next year up to three Whitworth Fellowships of £1,000 a year will be offered. This may be supplemented by allowances for dependants and travelling and subsistence. In addition up to three Whitworth Exhibitions of £100 will be awarded to unsuccessful candidates whose work deserves recognition. Applicants must be over the age of 25 and be in the possession of a university degree in engineering, a diploma in technology (engineering), a higher national diploma or a higher national certificate for engineering with at least two distinctions, or a qualification approved by the Ministry as of equivalent standard. They must have been successfully engaged as practising engineers for not less than three years.

Applications for the 1960 competition must be submitted to the Minister of Education by 3rd July. Full details are given in the new rules and conditions, obtainable from H.M. Stationery Office, price 4d, or by post 6d.

INDUSTRIAL NEWS

Prices and Sales

Figures released by the Board of Trade show that at 111·4 the provisional index number of wholesale prices of all manufactured products for March was fractionally lower than in February (1954=100). The price changes were, however, confined to a very few commodities. The rise in copper and brass prices is reflected in the index of materials and fuel used in the electrical machinery industry which rose to 116·3 in March compared with 115·8 in February. The wholesale prices index for domestic electrical appliances remained steady at 104·9—a slight rise on the average for 1958.

February is usually a quiet month for retail sales of durable goods and although expectations of lower purchase tax in the Budget probably held back some sales the hire-purchase business of household goods shops and finance houses continued strongly during February. Sales on hire-purchase and other instalment credit terms have accounted for all the increase in the business of these shops in recent months; cash sales have been running at much the same level as a year ago, suggesting that very little of the big rise in personal bank loans had been spent on household goods. The credit business of radio and electrical goods shops was 33 per cent above the level of a year ago. This improvement was presumably in goods other than television sets for the sales of these have been reported dropping back.

Sales by radio and electrical goods shops in February were 1 per cent down on February, 1958, and only 2 per cent higher than the average for the whole of last year. The value of sales and stocks of the radio and electrical departments of department stores was 17 per cent higher than in February, 1958.

Improved Export Prospects

The April issue of the "G.E.C. Export Guide" shows that export prospects are "good" and "improving" in twenty-one of the thirty-four countries listed. Among the countries where prospects are good are Canada and the United States, Switzerland, the Soviet Union, Ghana, Nigeria, Iran and Iraq. Trading conditions are "deteriorating" or "bad" in Australia, New Zealand, India, Argentina, Venezuela and the Netherlands.

In the past six years United Kingdom electrical machinery manufacturers have won some $50 million worth of orders in the United States. Not only is the United States Britain's largest export market but it is the one, according to a special article, that shows the greatest rate of growth. There may be good opportunities for some products, not at present exported, for which the demand is small by American standards but which British firms could satisfy economically. In addition, it may pay some firms to sell licence rights, to overcome tariff barriers, or to engage in joint manufacture. For the fullest results a careful study of American market requirements is needed, as well as more imaginative promotion and publicity.

Electrical Engineers' Exhibition

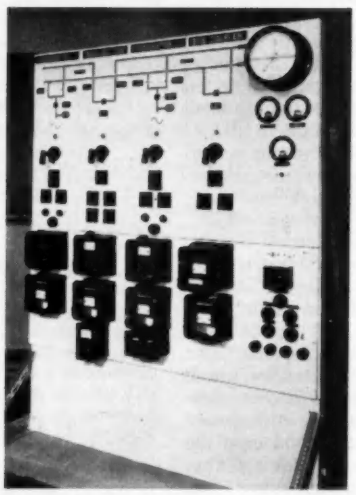
A meeting of the exhibitors at the 1959 Electrical Engineers' Exhibition is to be held at the Connaught Rooms, London, W.C.2, on 5th May (2.30 for 2.45 p.m.) to discuss this year's display and arrangements for next year's.

Visitors to the 1959 Exhibition numbered 68,249 and the organisers say that the Overseas Reception Room dealt with 639 inquiries from 71 different countries.

Control Engineers' Course

The North West, Merseyside and North Wales Region of the Central Electricity Generating Board initiated a new course at Electricity Hall, Buxton, on 16th March. The course, for control engineers, was arranged following a report made by the Region's Human-Error-Faults Committee which, among other recommendations, suggested the need for training to keep pace with the rapid development of equipment. A training working party recommended a short intensive course using specially designed equipment capable of simulating circumstances in which errors and faults might arise.

Two special panels were designed and made by the plant and equipment staff of the electrical engineering department and used by the lecturers. One panel incorporated a mimic diagram with control switches, protective and tripping relays, a variety of alarm schemes and a fully interlocked synchronising scheme including a synchroscope, incoming and running voltmeters, a phase-angle voltmeter and two motor-alternators which could actually be synchronised and paralleled. The second panel represented a three-switch substation with lighted mimic diagram and circuit-breaker control keys. Telephones and loudspeakers were used to simulate actual working conditions between the grid control engineer and the station control engineer. The systematic numbering of switchgear was fully illustrated by slides.



One of the demonstration panels used during the control engineers' course

Subjects covered by the course included layout of grid substations, significance of grid switchgear numbering, switching instructions, alarms, relay flags, tripping relays and emergency action. The course included a visit to Manchester grid control and the Carrington 275 kV and 132 kV substations.

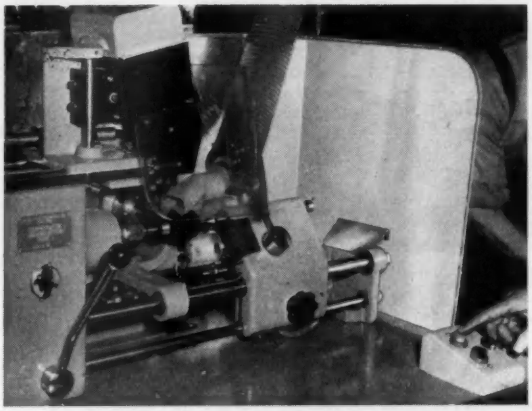
Copper Cables

A 62-page illustrated booklet, "Copper Cables," giving information about the many types of insulated copper cables available, has been issued by the Copper Development Association. The properties of copper and some of its alloys are dealt with and there are chapters devoted to such subjects as the manufacture of copper wire and the various types of power and telephone cables. An appendix giving constants and formulæ for resistance, inductance and capacitance of cables is included and there is a bibliography and a list of applicable British standards.

Copies of the booklet, C.D.A. publication No. 56, may be obtained free on request to the Copper Development Association, 55, South Audley Street, London, W.1.

Electronic Commutator Undercutting

A number of electronic armature undercutting machines made by E.M.I., Ltd., for automatically removing the rigid plastic insulation between copper commutator bars have been installed recently at the Perivale, Middlesex, factory of Hoover, Ltd. A ray of light is directed on the commutator and reflected to a photo-electric cell, and the indications given by the varying amounts of light reflected by the copper and black insulation segments are fed into an electronic control circuit. The commutator is stopped when the insulation is "viewed" and a rotary cutter removes the insulation. The whole process is automatic, the operator simply inserting an armature and starting the



Undercutting a commutator on the new machine

machine. It is estimated that the installation of these machines, which are operated by Hoover fractional horsepower motors, will result in a 30 per cent increase in output.

Engineering Workers' Holiday Pay

Agreement was reached at a meeting last week between representatives of the engineering employers and of the trade unions in the industry regarding increased holiday credits. The new arrangement provides for an increase of one-sixth as from 13th April. It was agreed to extend from six to twelve weeks the period during which holiday allowances are credited to workers absent on account of sickness or accident.

Air Duct Friction

A series of charts compiled to meet the needs of engineers concerned with ventilation and air conditioning and giving data on the friction of air passing through ducts and pipes has been published by the Sturtevant Engineering Co., Ltd. The charts, which are based on generally accepted hydraulic formulæ, cover such subjects as friction of air in ducts and pipes, temperature and roughness correction for duct friction, and equivalent duct diameters. Explanatory notes are given for each chart. Copies of the publication, No. 2007, may be obtained from the company at Southern House, Cannon Street, London, E.C.4, price 7s 6d.

Scottish Contractors' Conference

The annual conference of the Electrical Contractors' Association of Scotland will be held in the Marine Hotel, North Berwick, from 24th to 27th May.

Silicone Laminates

A booklet published by Midland Silicones, Ltd., 68, Knightsbridge, London, S.W.1, describes the properties and applications of silicone resin-bonded glasscloth laminates. These have good dielectric and mechanical properties and low moisture absorption, meeting the requirements of Classes H and C of B.S. 2757 : 1956 and DEF 5000. They have excellent arc resistance and can withstand temperatures up to 250 deg C. A list of manufacturers of silicone-glass laminates is given, typical properties are enumerated and there are graphs depicting the thermal endurance of glass cloth laminates impregnated by two different types of Midland Silicones laminating resins.

Applications described and illustrated in the booklet vary from printed circuit bases for TV turret tuners to h.f. communication equipment, rotary switches, electromagnets, transformers and aircraft electrical equipment, in addition to domestic convector heaters.

Copies of the booklet, "Silicone-glass Laminates," reference number Silicone Notes L18-2, are available from 68, Knightsbridge, or from the company's area sales offices.

Welsh Technical Information Service

Mr. A. J. Nicholas, managing director of South Wales Switchgear, Ltd., sponsored a reception which was held in Cardiff on 13th April for the informal launching of the Regional Technical Information Service for Wales, at which the objects of the Service were explained. It was stated at the reception that the advances made by technology in the last two decades were generally appreciated but not all firms operating in Wales were organised to digest and apply the technical information available. In many cases the answer to a technical problem already existed. The aim of the Service was to provide a pointer to that answer.

Surface Coating Index

A new "Surface Coating Resin Index" has been prepared jointly by the surface coating resin section of the British Plastics Federation and the Surface Coating Synthetic Resin Manufacturers' Association. The booklet, which replaces a similar index published in 1955, gives basic information on all British-made surface coating synthetic resins at present available. It is obtainable on application to the British Plastics Federation, 47-48, Piccadilly, W.1, or the Surface Coating Synthetic Resin Manufacturers' Association, 79-80, High Holborn, W.C.1, price 5s.

E.A.W. Area Conferences

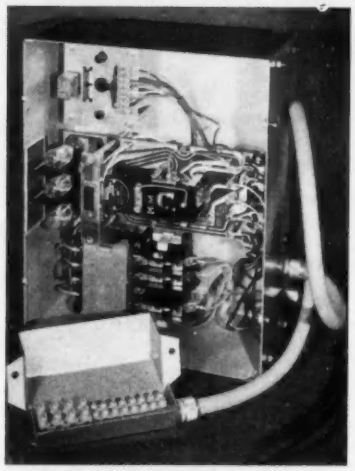
Two E.A.W. Area Conferences were held recently, when Mrs. M. E. Pickford, B.Sc., E.A.W. education officer, and holder of the 14th Caroline Haslett Travelling Exhibition, spoke on "A Month in America." The Yorkshire Area Federation Conference was held at Mirfield on 8th April and that of the North West England, Merseyside and North Wales Area Federation at Chester on 9th April.

Diesel-Electric Locomotive Equipment Order

The British Thomson-Houston Co., Ltd., has obtained from the British Transport Commission a further contract covering 37 B.R. Type 2 diesel-electric locomotive equipments, bringing the total of such equipments ordered from the B.T.H. Co. to 151. The equipments include traction generators, motors and control gear, with a Sulzer 1,160 h.p. at 750 r.p.m. pressure charged six-cylinder engine.

High Current Printed Circuits

The technique of printed circuits is normally associated with currents of the order of micro-amps, but a copper-clad laminate developed by Bakelite, Ltd., incorporating a foil circuit 0·0015in thick, is used for the control system of MacFire oil-firing units for boilers, connecting a motor relay,



Boiler firing unit controller incorporating a Bakelite 3 A printed circuit

timing device, circuit protection fuses, signal lights and a transformer. It is expected that other uses for this type of printed circuit will be found, as copper foil is now available up to 0·0045in thick, and capable of carrying currents of 10 A.

Catering Exhibition

Electricity for cooler, cleaner, quicker and cheaper catering was the theme of an electrical catering exhibition organised by the South Eastern Electricity Board which was held last week at Electric House, Wellesley Road, Croydon. In the arcade and demonstration theatre there were a number of stands displaying a wide

range of commercial and industrial catering equipment by fourteen exhibitors. Among the modern labour saving appliances of special interest to caterers were butter spreading machines, a rotary toaster, semi-automatic dish washers and sterilisers, refrigerators and cold storage units, heavy duty cooking ranges, food preparation machines, and electric fumigators.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 17th April is deemed to be 194s.

The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 17th April is 180·4 (1949=100) and 116·3 (1954=100); both figures are provisional. For turbo-generating and allied plant: Materials used in mechanical engineering industries 187·7 (1949=100) and 124·9 (1954=100); both figures are provisional. Blast furnaces and iron and steel melting and rolling (40 and 41) 190·8 (1949=100) and other steel goods, excluding tubes (311 and 312) 130·0 (1954=100). The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 17th April) is 47¾d per lb.

Industrial TV for Nuclear Research

The activities of the remote handling division of Savage & Parsons, Ltd., Watford, Herts., are being extended to cover the supply of closed circuit industrial television equipment to nuclear research and experimental establishments throughout the world. This is the main effect of an agreement announced between Savage & Parsons, Ltd., and Marconi's Wireless Telegraph Co., Ltd.

Floodlit Pedestrian Crossings

A pedestrian crossing has been floodlit as an experiment in Manchester Road, Bradford, and another experimental crossing is to be introduced shortly at Emm Lane.

Dimplex Sales Conference

An increase of over 50 per cent in sales over the previous year was reported by Mr. E. J. Wade, managing director of Dimplex, Ltd., at the company's national sales conference which was recently held at Millbrook, Southampton. Mr. H. R. Heath, director and secretary, who presided during the 5-day conference, presented the company's annual review which covered administration, production and sales policy. Mr. D. N. Dale, sales promotion manager, reviewed the 1958-59 campaign and outlined the 1959-60 campaign. At the annual sales conference dinner held at East Close Hotel, Hinton Admiral, Mr. Wade announced the appointment of

Representatives of Dimplex, Ltd., at the company's annual sales conference. In the centre of the front row can be seen Mr. D. N. Dale (sales manager), Mr. E. J. Wade (managing director) and Mr. H. R. Heath (director and secretary)

Mr. Dale as sales manager of the company. Mr. Dale will continue to be responsible for the direction of the Sales Promotion and Advertising Departments. Mr. Wade also announced the appointment of Mr. J. Fitter, A.M.I.H.V.E., as the company's technical sales heating engineer. The sales team has been further strengthened by the appointment of Mr. A. Dance as the company's West of England and South Wales representative and Mr. B. P. Davies as its Southern Area representative.

Traction Motors for Rhodesia

The Hunslet Engine Co., Ltd., on behalf of Hunslet Taylor Consolidated (Pty.), Ltd., Johannesburg, has placed a repeat order with Crompton Parkinson, Ltd., for sixteen traction motors for differential drive trolley locomotives, and also a development order for twelve traction motors for differential drive trolley locomotives for the Mufulira Copper Mines, Ltd., and the Mindola Shaft of the Rhokana Corporation.

Aluminium Cables

The fourth in a series of electrical handbooks published by Aluminium Union, Ltd., Adelphi, John Adam Street, London, W.C.2, "Aluminium for Insulated Cables," is an illustrated 72-page book containing a survey of established designs of aluminium conductor and aluminium sheathed cables. The techniques of jointing and installation are fully treated, the manufacture, use and protection of aluminium cables is described, and a chapter is devoted to the characteristics of aluminium. A bibliography is included and various appendices are given, including a comparison of the properties of metals used in cables, and current rating tables for paper insulated aluminium conductors with aluminium or lead sheaths.

Multi-Purpose Grid

A new multi-purpose grid which can be used to construct anything from industrial platforms and mobile stairs to car ramps and trolleys, will be shown at a Dexion Building Exhibition at Stonebridge Park, Wembley, from 26th May to 4th June. It is available in two sizes and a standard width and can be quickly bolted together with fixing plates and standard Dexion nuts and bolts to suit almost any purpose where a grid work or flooring is needed in any industry.

The grid will be available in 9in widths, and in standard lengths of 4ft 6in and 6ft only. Non-standard lengths in multiples of 1½in will be available in minimum quantities of twelve.

Pneumatics and Hydraulics Exhibition

A Pneumatics and Hydraulics for Industry Exhibition and Convention is being organised by Macfarlane Watson, Ltd., 36, Beauchamp Place, London, S.W.3, to be held at the Alexandra Palace, London, N.22, from 12th to 16th October next. Admission will be free by ticket only.

Principles and Applications of Selsyns

A booklet has been published by the British Thomson-Houston Co., Ltd., dealing with selsyns. Some aspects of the principles of operation are first considered, followed by the design calculation of torque. After a description of the various types of selsyns, many practical details regarding the application of these units to various control schemes in different industries are considered. Professional engineers may obtain a copy of this 48-page booklet, which is illustrated with over 40 diagrams and photographs, free of charge by applying to the Publicity Department of the B.T.H. Co. at Rugby.

Electrical Resistance Materials

A book dealing with the properties of their range of electrical resistance materials has been published by Henry Wiggin & Co., Ltd. The characteristics and applications of the "Ferry," "Monel" and "Brightray" series and nickel alloys are summarised, and the physical, mechanical and electrical properties tabulated. This is followed by a section devoted to general information dealing with specific resistance and the temperature coefficient of resistance, temper and finish, special grades, tolerances and reel and coil sizes. The design of various forms of heating installation is then discussed, from domestic heating to industrial furnaces. The second half of

the book is devoted to tables of resistance and current carrying capacity of the range of wires produced by Henry Wiggin, concluded by constants, formulæ and conversion factors.

"Wiggin Electrical Resistance Materials" is obtainable free on request by electrical designers applying under their company's letterhead to Henry Wiggin & Co., Ltd., Publications Department, 20, Albert Embankment, London, S.E.11.

Electrolytic Conductivity Cells

An illustrated brochure describing the construction and use of electrolytic conductivity measuring cells has been published by Electronic Switchgear (London), Ltd. The cells, connected to an indicating instrument, measure the specific conductivity of electrolytes which can be made to flow through the cell or to be maintained in continual contact with it. A precisely determined volume of the electrolyte is contained between two electrical contacts of special construction, the spacing and area of which fix the electrical constant of the cell. Details are given of cells for flowline or immersion installations, cells for use in open tanks, and a sampling cell in which a small volume of the electrolyte is drawn into the cell bore by a rubber bulb. Copies of the brochure are obtainable from the company's publicity department at Works Road, Letchworth, Herts.

Road Traffic Control

A pamphlet received from the Automatic Telephone & Electric Co., Ltd., Strowger House, Arundel Street, London, W.C.2, gives details of their latest Type 54 vehicle actuated road traffic controller. Following a general description of the unit, the various control facilities available are enumerated, and the first installation of this equipment, in Liverpool, is illustrated.

Industrial Safety Conference

The largest industrial safety conference ever to take place in Great Britain will be held at Scarborough from 8th to 10th May. The conference is organised by the Royal Society for the Prevention of Accidents and inquiries should be addressed to the Industrial Safety Division of the Society, Artillery Mansions, 75, Victoria Street, London, S.W.1 (telephone: Abbey 6963).

Trade Announcements

A new sub-office of the **English Electric Co., Ltd.**, has been opened at 14, Albert Road, Middlesbrough (telephone: Middlesbrough 44346/7). Mr. A. R. Johnson, B.Sc., A.M.I.Mech.E., A.M.I.E.E., A.M.I.Prod.E., is in charge and is responsible to Mr. W. D. M. Lywood, A.M.I.E.E., manager of the branch office at Newcastle-on-Tyne.

The Electric Motor Division of **Newman Industries, Ltd.**, has opened an additional area office at 59, Grey Street, Newcastle-upon-Tyne, 1 (telephone: 2-3970). The new area manager is Mr. R. Martindale. A stores, adjacent to the new office, will carry stocks of electric motors.

Johnson, Matthey & Co., Ltd., have acquired an interest in Metalli Preziosi S.p.A. of Milan.

Londex, Ltd., has appointed **Harold Hubbard, Ltd.**, 2, Aylsham Road, Norwich (telephone: 25941), as technical representatives for the counties of Norfolk and Suffolk.

The Birmingham service depot of **Siemens Edison Swan, Ltd.**, is moving on 1st May to new premises at 76-80, Sherlock Street, Birmingham, 5 (telephone: Midland 0072). From 1st June the telephone number of the company's Birmingham district office will be Midland 8391.

An exhibition of its range of industrial control equipment and electronic instruments is being held by **Airmec, Ltd.**, from 12th to 14th May at the Engineering Centre, Stephenson Place, Birmingham, 2. Several new instruments will be demonstrated and of particular interest is the automatic co-ordinate setting equipment Type N271, which provides accurate remote control of the lead screws of co-ordinate tables.

The trading activities of the **Alton Battery Co., Ltd.**, have been taken over by the **Pritchett & Gold & E.P.S. Co., Ltd.**, Dagenite Works, Dagenham Dock, Essex, which has been manufacturing on behalf of the Alton Battery Co. since early 1958.

The **Ransome & Marles Bearing Co., Ltd.**, has moved its London office to new and larger premises at Cranmer House, 39, Brixton Road, S.W.9 (telephone: Reliance 6771 and telex 25237).

Mr. H. R. Davies has joined the Ferguson Division of **Thorn Electrical Industries, Ltd.**, as sales representative for West Lancashire.

Heat Regulating Plug

In our issue of 10th April (p. 700) a description was given of the new Sunvic Controls "Reguplug" heat regulating plug. It should have been made clear that these were pre-production units and that supplies will not be generally available until July.

C.E.G.B. CONTRACTS

The Central Electricity Generating Board has placed contracts during the past month for power stations, transmission lines and transforming stations amounting to about £7,567,000. They include the following:—

Northfleet power station: Coal handling plant—civil works. Rail tracks and ancillary works on sites.—Taylor Woodrow Construction.

Richborough: Reinforced concrete piling.—West's Piling & Construction Co. Coal handling plant.—George Wimpey & Co.

West Thurrock: Coal unloading cranes.—Stothert & Pitt. Ash handling plant.—Babcock & Wilcox.

Padiham "B": Slag conveying plant.—Mitchell Engineering Co.

Rugeley: Instruments and controls—Nos. 3, 4 and 5 units.—Electroflo Meters. Integral reheater inlet and outlet piping.—Babcock & Wilcox. 132 kV cables.—W. T. Henley's Telegraph Works Co.

Willington "B": 415 V contactor switchgear. — Watford Electric & Manufacturing Co. 275 kV switchgear.—British Thomson-Houston Co.

Uskmouth "B": Building superstructure and other works.—John Morgan (Builders). Main, auxiliary, control and instrument cables.—London Electricity Board.

Staythorpe "B": Auxiliary, control and instrument cables and earthing.—W. T. Henley's Telegraph Works Co.

Blyth power station: 275 kV switchgear.—A. Reyrolle & Co.

Windscale: Two 30 MVA, 132/11 kV transformers.—C. A. Parsons & Co. 132 kV switchgear extensions.—Metropolitan-Vickers Electrical Co.

Bethnal Green substation: Two 30 MVA, 66/33 kV transformers.—Johnson & Phillips.

Holborn (Back Hill) substation: One 45 MVA 132/33 kV transformer.—Hackbridge & Hewittic Electric Co.

Rame substation: One 45 MVA 132/33 kV transformer.—Brush Electrical Engineering Co.

Padiham substation: Two 45 MVA 132/33 kV transformers.—Metropolitan-Vickers.

Netley Common substation: Two 45 MVA 132/33 kV transformers.—Hackbridge & Hewittic Electric Co.

New Mills substation: Two 45 MVA 132/33 kV transformers.—C. A. Parsons & Co.

Shenfield substation: Two 45 MVA 132/33 kV transformers.—Hackbridge & Hewittic Electric Co.

Adswood substation: Two 45 MVA 132/33 kV transformers.—B.T.H. Co.

Checkerhouse substation: Two 45 MVA 132/33 kV transformers.—Crompton Parkinson.

Rodley substation: One 60 MVA 132/33 kV transformer.—Ferranti.

Norton substation: One 120 MVA 275/132 kV transformer.—B.T.H. Co.

Stalybridge substation: Four 180 MVA 275/132 kV transformers.—Metropolitan-Vickers.

Creyke Beck-Hull West: 132 kV overhead line.—Pirelli-General.

Lynes Common substation: 132 kV switchgear.—General Electric Co.

Wimbledon substation: 132 kV switchgear.—B.T.H. Co.

Lackenby substation: 275 kV switchgear.—A. Reyrolle.

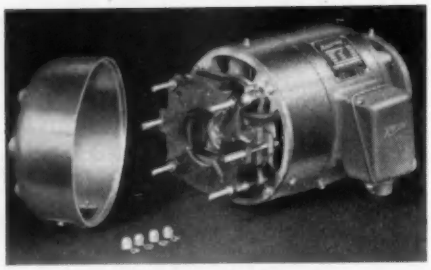
Ffestiniog substation: 275 kV isolators, protection and ancillary equipment.—Ferguson Pailin.

NEW ELECTRICAL EQUIPMENT

Brake Motors

A comprehensive and low-priced range of brake motors recently announced by NEWMAN INDUSTRIES, LTD., Yate, Bristol, incorporate an electromagnetic brake, designed on the disc principle and actuated by the normal a.c. supply.

During 1959 a range of these electromagnetic disc brakes suitable for building into any of their f.h.p. and industrial three-phase motors of the drip-proof or totally enclosed types up to 15 h.p. will be introduced. The brakes will have retarding torques from 2·9 to 144 lb-ft. A variety of torques will be available for each h.p./frame size of motor so that, within limits, the retarding torque can be matched to the requirement of the application rather than the speed or horsepower of the motor. The first unit, now in production, has a torque range of 5·7-21 lb-ft and the torque can be varied between these limits by a simple adjustment of the compression of the brake springs.



Newman brake motor

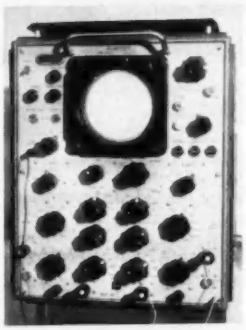
The brake is of the fail-to-safety type and operates from a three-phase supply; it is automatically applied if the motor supply fails. The brake may be released manually if required, however, for adjustment. A brake motor of 3 h.p. 1,460 r.p.m. with a maximum retarding torque of 14½ lb-ft is only four inches longer than an ordinary motor of the same rating.

Infinite Persistence Oscilloscope

The study of transient phenomena may be undertaken using the latest oscilloscope, the type QD910, introduced by the SOLARTRON ELECTRONIC GROUP, LTD., Thames Ditton, Surrey. This incorporates a 5in diameter storage cathode ray tube having an infinite trace persistence, though the trace may be erased as desired immediately each investigation is completed.

The oscilloscope is a dual channel instrument, each channel having a bandwidth from d.c. to 1 Mc/s. Provision for external brilliance modulation of the time base waveforms has been included and delay pulses are brought out to the front panel. An internally generated waveform provides automatic erasing for initial setting of the tube controls. Transient phenomena may be located by using an operating mode in which the time base makes a single sweep and the resultant trace is stored for any period up to 100 sec. The trace is then automatically erased and the sequence repeated.

The unit has a sensitivity from 10 mV to 30 V per cm in eight ranges, with sweep times varying from 10 μsec to 100 sec for a 10 cm sweep. The instrument is suitable for connection to 100 /220 V ±20 V, 50 or 60 c/s supply and the consumption is approximately 500 W.



Solartron infinite persistence oscilloscope

Contact Lubricant

A lubricating fluid for contact surfaces is now available from ELECTROLUBE SALES, LTD., 3, Red Place, Green Street, London, W.1. This fluid, marketed under the trade name "Electrolube," is chemically inert, non-aqueous, carbon free and has a comparatively low resistance for oil coupled with a negative resistance/temperature characteristic. When placed between two surfaces in contact it penetrates chemical films and, by virtue of its low resistance, increases the area through which current can flow, eliminating point contacts. When the contacts separate, the fluid temperature is raised by the current flowing, its resistance falls and current continues to flow after metallic contact has ceased, preventing current concentration at point contacts causing damage to the contact faces.

High Powered Stroboscope

Stroboscopes are widely used in industry to study machinery and manufacturing processes under actual operating conditions. The Type 6 instrument introduced by E.M.I. ELECTRONICS, LTD., Hayes, Middlesex, uses an ultra-high-intensity xenon discharge tube and has a flash rate of 60,000 flashes per minute. If the stroboscope is made to flash at a submultiple of the speed of the body under inspection, observations and speed measurements may be made at speeds in excess of 60,000 r.p.m.

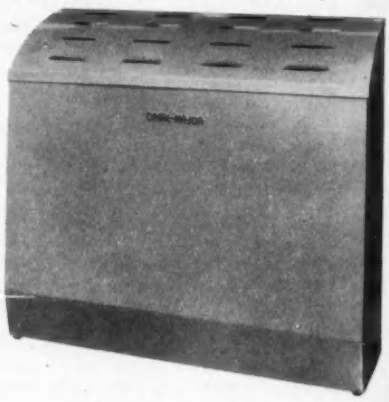
E.M.I. stroboscope

The instrument has a light output up to 2,000,000 mean spherical candlepower and the flash colour closely approximates to daylight. Built-in facilities include a photo-electric probe, a photo head amplifier and a light diffuser for work in silhouette. The stroboscope can be synchronised by a mechanical contactor, photo electric head, and a sine wave or pulse voltage input. A free standing lamp with large reflector is detachable and can be used up to 9ft away from the instrument.

Drying Cabinet

An all-purpose drying cabinet/space heater, the Drial-Major "Condri," will shortly be marketed by B. J. & W. AUTOMATION, LTD., 9, Curnock Street, London, N.W.1. It measures 34in high by 36in wide by 10in deep and is finished in stove enamelled hammer oxidised copper or silver. It has a sloping louvred lid and is designed to

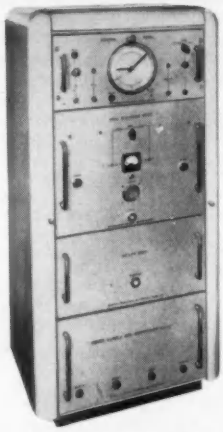
Drial-Major "Condri" drying cabinet/space heater (B. J. & W. Automation, Ltd.)



stand against the wall when in use as a space heater. Three 600 W heating elements are fitted, controlled by two switches, as well as a fan. The four aluminium drying rails give an equivalent of 12ft of clothes line and the price is £19 19s including purchase tax.

Industrial Process Control

A new programme recording and playback equipment announced by VENNER ELECTRONICS, LTD., Kingston By-Pass, New Malden, Surrey, has been designed to control the sequence and timing of industrial processes. It is capable of providing up to 49 on-off switching actions on independent or common circuits as required and it can be used to programme any process in which the sequence of events can be controlled by the timed operation of



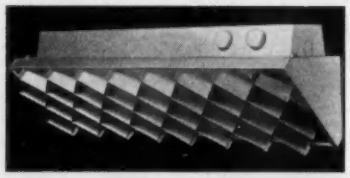
Venner programme record/playback console

a number of contacts. This system enables the timing of any part of the process to be altered as desired and the sequence of events can be adjusted without major wiring modifications.

The command pulses are stored on standard magnetic recording tape. From a single master tape an unlimited number of copies can be made for the independent control of a number of machines or for use by the various branches or overseas subsidiaries of a manufacturer. A total operating period of up to 2½ hr is standard but special units are available for longer periods.

Shop Window Reflector

The new range of "Realite" shop window reflectors available from ROWLANDS ELECTRICAL ACCESSORIES, LTD., Hockley Hill, Birmingham, 18, combines a highly efficient angle type trough reflector with a specially designed deep louvre fitting to eliminate side glare. They can also be supplied without louvres for use in situations where sidelight throw is not objectionable. The dimensions have been kept as small as practicable so that the fittings can be completely hidden behind a shallow 8in pelmet.



Rowlands "Realite" louvred shop window reflector

The fittings are designed for chain suspension and the control gear is mounted on the top of the reflector member, under a protective housing. The reflecting surface is close grain aluminium spray. The prices, complete with switch start gear (suspension chain not included) range from £12 for the two 5ft 80 W tube fittings, with louvre, to £5 5s for the single 2ft 40 W fitting, without louvre.

Earthing Clamp

A universal earthing clamp in which the earth wire is in parallel contact with the pipe or earthing rod is now being manufactured by the BOWTHORPE ELECTRIC CO., LTD., Gatwick Road, Crawley, Surrey. It consists of a saddle and pressure pad manufactured from ⅛in thick brass, the saddle being 1in long, secured by a $\frac{5}{16}$in brass bolt.

Bowthorpe earthing clamp

Each clamp is supplied with 6in of 0·625in by 0·015in thick brass strip, and all parts are tinned overall. When applied to a 1·2in dia. mandrel and with a 7/·064 earthing lead a resistance of 0·12 mΩ was measured while with a 0·49in mandrel and a 7/·036 lead the corresponding resistance value was 0·15 mΩ.

Retaining Rings

Nylon retaining rings developed in Holland for locking and sealing nuts on a screw thread are now available in this country from the sole concessionaires, FAN DISC, LTD., 109/111, Northwood Street, St. Paul's, Birmingham, 3. The rings are made from a nylon type material, "Akulon," a super-polyamide, one property of which is the ability to flow under pressure. When placed on a bolt and the nut tightened, the ring begins its cold flowing action. The inner diameter grips the threads of the bolt and nut and flows into the opening of the tapped hole, while the outer diameter flows over the edges of the nut, completing the locking and sealing. The rings have considerable shock absorbing properties, are resistant to corrosion and most chemical agents, and have good electrical insulating properties.

Microwave Valves

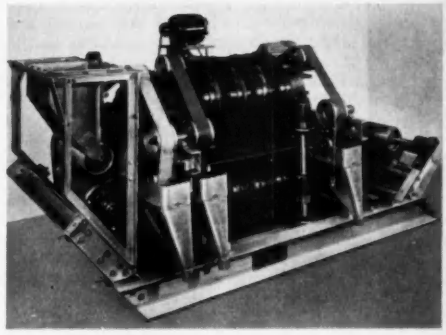
The introduction of new microwave valves has been announced by MULLARD, LTD., Mullard House, Torrington Place, London, W.C.1. The JN2-2·5W is an unpackaged, continuous-wave magnetron for operation in the frequency band 2,425 to 2,475 Mc/s. It delivers a maximum power output of 2·5 kW and is designed for coupling to a 50 ohm coaxial line. The valve is intended as a c.w. power oscillator in industrial microwave heating generators. The type JP2-02 is a packaged, continuous-wave magnetron designed expressly for low-power microwave heating applications, including diathermy. It operates within the frequency band 2,425 to 2,475 Mc/s and is capable of delivering a c.w. output power of approximately 200 W. The valve is designed for coupling to a 50 ohm coaxial line, and requires no artificial cooling when suitably mounted on a heat sink.

Magnetic Separator

The magnetic separator of the cross-belt type manufactured by the Fraser & Chalmers Engineering Works of the GENERAL ELECTRIC CO., LTD., at Erith, Kent, has recently been redesigned as a unit machine. The magnetic flux is produced by eight coils, four on the upper magnet and four on the lower, which take a current of 3 A at 110 V d.c. A 15in feed belt carries material through the air gap between two pairs of poles, the upper poles being tapered and fitted with high-permeability alloy tips to concentrate the magnetic field. The feed belt is motor driven through a positive infinitely variable chain gear, with a speed range from 20 to 240 ft/min. The cross belts are driven by a separate motor through a variable-speed gear, and can be regulated between 250 and 1,000 ft/min.

The framework of the machine, including the upper assembly, is of aluminium, while the posts and handwheels are of brass. Leakage of magnetic flux is thus almost entirely eliminated and virtually all the flux can be concentrated in the space

G.E.C. magnetic separator



between the poles. A field strength as high as 18,000 gauss is obtainable at belt level with a ¼in gap between the upper and lower poles.

Socket-Outlet Pattresses

A range of pattresses suitable for installing surface mounting socket-outlets in accordance with I.E.E. Regulation 207(G) is being offered by J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall, Staffs. Each pattress is a robust moulding into which the base of the accessory can be recessed and the result is a neat assembly having minimum projection. Cables may be brought in through knockouts in the sides or at the back, and there is also adequate space for cable slack. Where a very large amount of cable has to be accommodated, additional room can be made by using packing sleeves around the accessory-fixing screws.

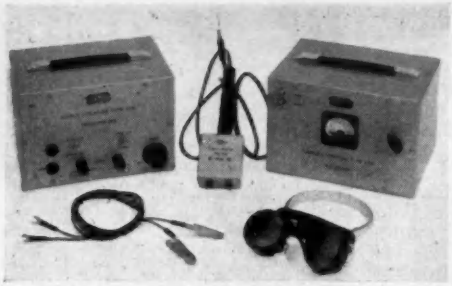
Two of the new pattresses from the Crabtree range

Cable Locator

The type 278 cable locator introduced by AIRMEC, LTD., High Wycombe, Bucks., has two main functions, the identification of one cable in a group and the detection of a cable carrying current. It is intended for use when a cable requires to be broken either for repair or the extension of a service.

The equipment consists of two small battery-operated units, a transmitter and a receiver, incorporating transistors and printed circuit techniques to reduce both size and weight. The transmitter, which generates an interrupted a.f. signal, is connected to the end of the required cable and the signal is picked up by the receiver when the probe is placed near the correct cable, an interrupted note being produced in the headphones and the 2½in square micro-ammeter on the front panel registering a series of indications. Mains frequency currents in power supply cables can be detected by the receiver alone, a continuous meter reading being obtained and a 50 c/s note being produced in the headphones.

The transmitter is operated from a 4 V dry accumulator, maintained by a built-in trickle charger operating from a 200-250 V 50 c/s supply, while a 4·5 V dry battery is used as the power source for the receiver. The equipment includes two 5ft output leads, an inductive pick-up probe complete with 6ft leads and a pair of 600 Ω headphones.



Airmec cable locator

Circular fluorescent and tungsten lighting fitting (Electricals, Ltd.)

Industrial Lighting Fitting

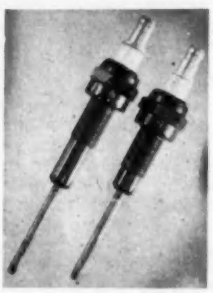
A new dustproof circular fluorescent and tungsten fitting is the latest addition to the "Ampolite" range of flameproof and industrial lighting fittings available from ELECTRICALS, LTD., 14, Claremont Place, Newcastle-upon-Tyne. The fitting is suitable for a variety of applications in industry and mining and can be used on either mains voltages or an emergency lighting supply. Models are available for 110 or 200/250 V.

The unit is colour corrected, by the blending of the 80 W fluorescent and tungsten lamps, and has an armour-plate glass cover. Other features claimed are that it is proofed against corrosion; operates in sub-zero temperatures; reduces stroboscopic effects; and gives an increased light output with an all-round distribution. The price, with fluorescent tube, is £17 5s.

Plug for Diesel Engines

A glow plug for diesel engines, incorporating a sheathed element, has been produced by K.L.G. Sparking Plugs, Ltd., in conjunction with the Metropolitan-Vickers Electrical Co., Ltd. A number of specific advantages, including increased efficiency, are claimed for the new plug. With an end diameter of ¼in, compared with the approximately ¼in diameter of the average conventional exposed coil plug, the new sheathed element heater needs a correspondingly smaller entrance hole into the pre-combustion chamber, allowing larger coolant passages around the chamber and reducing lost compression effect, thus improving power output.

The heating element is protected from combustion gases and the wire can be of very thin gauge. The element can be designed to work at the full battery voltage and the plugs can be wired in parallel instead of series. This obviates the need for voltage dropping ballast resistors and prevents the engine becoming inoperative as a result of a single plug failure.



Long and short reach sheathed element glow plugs

The sheathed element, which has been developed by Metropolitan-Vickers, consists of a heating coil which is fed with its connecting wire into a tube of pure magnesium, the two being fitted into an Inconel, nickel alloy, sheath. The ends are plugged and the process of converting the magnesium into magnesium-oxide —the insulating medium—is carried out in two stages: firstly magnesium hydroxide is produced in an autoclave where steam under high pressure and temperature reacts on the magnesium, and then the water is driven off in an oven. The conversion process results in expansion and this tightly packs the magnesium oxide between the heating coil and sheath, providing support for the wire, good insulation and heat conduction. Finally, one end is closed and welded; one end of the coil is attached in the process, and the tail wire at the other end is sealed with a glass bead to keep out moisture.

A warm-up time of approximately 20 seconds is required before engine starting. Tests have shown that, although heating is desirable over approximately one inch of the element to provide adequate thermal capacity, only the extreme tip need project into the pre-combustion chamber for satisfactory starting, and this shows that the aid to starting is by hot spot effect rather than by augmenting the heating effect of compression raising the temperature of the mixture.

GENERATION and DEVELOPMENT

Experimental Remotely Controlled Power Stations

As an experiment, the South Western Electricity Board is to install two completely automatic "pocket" power stations operated by remote control. Announcing this last week, a Board spokesman said that the power plants would be modified land designs of the Bristol "Britannia" aero engine. Although unsuitable for continuous running, they would be excellent for standby use if the mains supply failed. They would be sited in the remoter parts of the West Country where supplies were dependent on a single line, so postponing the need for additional overhead lines. Not only would they make the supply more reliable, but they would also reduce the Board's demands on the national network.

The siting of the two generating sets was at present under consideration, he said. One possible site was at Princetown in Devon where the installation of the new power plant would enable a reliable supply of electricity to be given without the complication and expense of constructing a second 33 kV line across the Dartmoor National Park.

The "pocket" power station is no bigger than a small house (35ft by 23ft and 20ft high) and the 3,000 kW turbo-generator weighs little more than a ton. A model is on view for the first time at the Engineering, Marine, Welding and Nuclear Energy Exhibition.

M.E.B. Districts Merged

The Midlands Electricity Board announces that its Stone and Market Drayton District is to be merged with its Newcastle and Stafford Districts. The change takes effect on 1st May. The town of Market Drayton and surrounding area will become part of Newcastle District and the remainder of the Stone and Market Drayton District will be included in the Stafford District. Mr. G. L. Brown, at present district consumers' engineer at Stone, has been appointed manager of the Stone Branch of the Stafford District and will continue to serve the interests of local consumers from the M.E.B. premises at 69, High Street, Stone. Mr. C. J. Moore will remain as manager of the Market Drayton Branch of the Newcastle District, with offices at Great Hales Street, Market Drayton. Mr. J. E. France remains manager of the enlarged Newcastle District and Mr. J. G. Kellie manager of the larger Stafford District.

Payment of Bills by Instalments

The possibility of providing for the payment of electricity bills in weekly or fortnightly instalments was discussed at a recent meeting of the North Eastern Electricity Consultative Council. The chairman, Mr. D. G. Brown, said that many complaints were being received about the difficulty of meeting quarterly bills.

Mr. E. Bates (chief commercial officer of the Board) said that systems of fortnightly payments were in operation in other parts of the country and could easily be adopted in thickly populated areas. It would not be an economic proposition to use this method in thinly-populated areas, however, and it might be necessary to install prepayment meters. Information on the subject was being obtained from other Boards and it was hoped that a decision would be reached soon.

Metering in Flats

Instead of having to visit each flat the meter reader of tomorrow will go to a ground floor room and there read all the meters in a row. These will be simple inexpensive repeaters of the meters installed in each flat. A prototype of a meter for this purpose, manufactured by Smith Meters, Ltd., was on show for the first time at the "All-Electric" Housing Exhibition organised in Perth by the North of Scotland Hydro-Electric Board. Ministry of Power approval will be required before the new meters can be used.

OVERSEAS

Load Building in Guernsey

In his report for 1958 Mr. I. F. Young, M.I.E.E., engineer and manager of the States of Guernsey Electricity Board, says that the year was a particularly successful one for the contracting section. A policy of load building all around the clock is being sponsored and to this end the Board's off-peak tariff is under revision. Among large installation contracts two—at the offices of the Tomato Shipping Board and Mackay & Co., Ltd.—included electric floor warming.

Though the year began with a fall in consumption, the rate of progress for the year as a whole was higher than that forecast in 1956 for the ensuing ten years. Sales totalled 29·2 million kWh, an increase of 10·8 per cent, and there was a net surplus on the year's operations of £35,308 (against £25,342). The average price received per kWh sold decreased from 3d to 2·9d.

Reference is made in the report to several failures of major items of generating plant and to the need for maintaining adequate capacity. On the distribution side it is indicated that a major scheme of reinforcement, involving the raising of the voltage of the ring main system from 6·6 to 11 kV, will soon have to be undertaken.

At the request of the States Water Board the possibilities of joint operation of a scheme for producing fresh water from sea water by the Flash evaporation process were examined. The intention was to provide facilities for water production from a steam plant designed to generate electricity, but the evidence was conclusive that such a scheme in Guernsey would not reduce the costs of operation of either Board.

Volta River Development

A contract was signed in Accra last week between the Government of Ghana and the American concern, Henry J. Kaiser. It provides for further exploratory work on the Volta River hydro-electric project, the determination of the basic design of the scheme and the construction of access roads. The idea is to clear the way so that the main work can proceed at once when it is decided to go ahead with the scheme.

The contract follows a report prepared by the Kaiser concern which is said to be favourable to the development. It is proposed to move the site of the main dam from Ajena, the original point, to Kosombo, about a mile south. Here it is proposed to erect a 768 MW plant, at an estimated cost of £55·7 million, the work taking 5½ years to complete. It is also recommended that a dam and a 115 MW station should be erected at Kpong at a cost of £15·5 million and, some time later, a further dam and 93 MW plant at Bui.

The Government of Ghana has asked the United States Government to use its influence to interest American aluminium producers and other large-scale power users in the Volta River project.

Peace River, B.C., Project

Speaking in London last week, Mr. W. C. Mainwaring, president of the Peace River Power Development Co., gave some details of the proposals for developing electricity from the Peace River, British Columbia. He said that the power available at one of the sites chosen was about 4 million h.p. Pulp and paper and petrol-chemical industries could be set up in the area and power would also be transmitted at 500 or 600 kV to the Vancouver area.

Application for permission to proceed would be lodged with the Provincial Government by the end of the year and it was hoped to place the first contracts reasonably early next year. Expenditure was estimated at $500 million in the first five years and $1,000 million in ten years.

Mr. Mainwaring said that the United Kingdom was providing $2 million of the $2½ million to be spent on preparatory work. This was additional to the funds being spent by the Wenner-Gren Development Co.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1945

22512. Thompson, R. W.—Method of electromagnetically separating ionic isotopes. 31st August, 1945. (812122.)

1954

11535. General Electric Co., Ltd., and Mannering, M. H.—Processes for the electrical treatment of organisms. 21st July, 1955. (812124.)

12278. Lancashire Dynamo Electronic Products, Ltd.—Speed regulating systems for electrical machines. 28th July, 1955. (812401.)

16439. Murkham, L. W.—Electromagnetic transducers. 22nd August, 1955. (812348.)

21858. Gill, Ltd., R. T., and Gill, R. T.—Thermionic valve circuits. 19th July, 1955. (812270.)

22943. English Electric Co., Ltd.—Electrical circuit means for producing a stabilised difference between the currents in two electrical circuit elements. 5th August, 1955. (812127.)

23009. Electric & Musical Industries, Ltd. —Bridge circuit arrangements especially for indicating the intensity of high frequency electric fields. 5th August, 1955. (812129.)

1955

2519. Associated Electrical Industries, Ltd.—Torsion meters and other rotating indicating devices. 27th January, 1956. (812405.)

4884. London Electric Wire Co. & Smiths, Ltd.—Chromium copper alloys. 9th February, 1956. (812407.)

18528. Lodge-Cottrell, Ltd.—Automatic voltage control of precipitator rectifiers. 27th June, 1956. (812277.)

18547. Wellman Smith Owen Engineering Corporation, Ltd.—Air cooled dynamo-electric couplings, dynamometers and brakes. 27th June, 1956. (812141.)

21274. Amp, Inc.—Electric shielded wire connector, connection and method of and apparatus for making a connection. 22nd July, 1955. (812279.)

22481. General Electric Co.—Ferroelectric ceramic compositions. 4th August, 1955. (812344.)

28664. Hewlett-Pacard Co.—Variable frequency oscillators. 7th October, 1955. (812282.)

29029. British United Shoe Machinery Co., Ltd.—Machines adapted for use in belting lead-bearing electrical components. 12th October, 1955. (812153.)

33103. Brooke, W., and Howe, H.—Means for effecting a symmetrical phase displacement in polyphase supply systems. 18th November, 1955. (812157.)

1956

8325. General Electric Co.—Ceramic compositions. 16th March, 1956. (812343.)

8584. Ferranti, Ltd.—Electrical transformers. 17th June, 1957. (812162.)

9765. M-O Valve Co., Ltd.—Manufacture of interdigital metal structures. 18th March, 1957. (812163.)

13334. British United Shoe Machinery Co., Ltd.—Machines adapted for use in assembling electrical components upon workpieces. 1st May, 1956. (Addition to 802658.) (812170.)

16119. Hazeltine Corporation.—Television apparatus. 24th May, 1956. (812175.)

17103. Spirax-Sarco, Ltd.—Thermostatic valve-actuating devices. 3rd June, 1957. (812389.)

17737. National Research Development Corporation.—Snap-action mechanisms and electric switches. 1st May, 1957. (Cognate application 34918, 15th November, 1956.) (812433.)

17874. Siemens-Schuckertwerke A.G.—Processes for the manufacture of sintered bodies having soft magnetic properties. 8th June, 1956. (812295.)

18437. Gresham Transformer, Ltd., Palmer, J. O. M., and Palmer, B. S.—Electrical contact devices. 14th June, 1957. (812391.)

19416. Standard Telephones & Cables, Ltd.—Manufacture of electric discharge devices. 22nd June, 1956. (812179.)

20025. Tyer & Co., Ltd.—Polarised electromagnetic relay. 27th August, 1957. (812181.)

23133. Marconi's Wireless Telegraph Co., Ltd.—Distributor switches for high frequency feeders. 22nd March, 1957. (812184.)

24536. British General Manufacturing Co. (1941), Ltd.—Plugs for electric couplings. 23rd July, 1957. (812399.)

25228. Western Electric Co., Inc.—Methods of and apparatus for twisting wires. 17th August, 1956. (812192.)

25524. Vorkauf, H.—Water tube steam boilers. 21st August, 1956. (812442.)

25804. Inventa Aktiengesellschaft für Forschung und Patentverwertung.—Voltage generator for a projectile electric detonator. 23rd August, 1956. (812400.)

27766. British Thomson-Houston Co., Ltd.—Electromagnetic pumps. 26th August, 1957. (812195.)

27950. General Electric Co., Ltd.—Aerial systems. 30th October, 1957. (812196.)

28356. General Electric Co.—Control systems for rotary shears. 17th September, 1956. (812450.)

28560. General Electric Co., Ltd.—Methods of and apparatus for detecting leaks in apparatus such as heat exchangers. 17th September, 1957. (812198.)

30606. Philips Electrical Industries, Ltd. —Devices for making or reproducing recordings, more especially but not exclusively magnetic recordings. 8th October, 1956. (812456.)

32152. Borg-Warner Corporation.—Electric control mechanism. 22nd October, 1956. (812459.)

33211. Lindberg Engineering Co.—Induction heating furnace and method of heating. 31st October, 1956. (812206.)

33249. British Thomson-Houston Co., Ltd.—Control systems for electric motors. 19th September, 1957. (812464.)

34004. Forges et Ateliers de Constructions Electriques de Jeumont.—Railway signalling track circuits. 7th November, 1956. (812465.)

34547. Zeiss Ikon A.G.—Recording and reproduction of signals produced by television means. 12th November, 1956. (812468.)

35308. Du Pont de Nemours & Co., E. I. —Dielectric films of thermoplastic polymers. 19th November, 1956. (812470.)

36835. Standard Telephones & Cables, Ltd.—Arrangements for testing radio repeaters. 3rd December, 1956. (812212.)

38586. Diamond Alkali Co.—Electrically conductive compositions. 18th December, 1956. (812304.)

1957

2200. Carr Fastener Co., Ltd.—Electric lamp sockets. 1st August, 1957. (Addition to 805340.) (812221.)

3779. Ohlsson, O. A.—Steam generators or heating boilers. 4th February, 1957. (812224.)

4962. Balestrini, R. H.—Electric heating devices. 13th February, 1957. (812225.)

8487. Rutenbeck, E. (trading as Franz & Rutenbeck).—Means for suspending overhead electric cables and the like. 14th March, 1957. (812311.)

11671. Standard Telephones & Cables, Ltd.—Electro-mechanical transducers. 10th April, 1957. (812312.)

14477. Clark Equipment Co.—Electric truck control. 7th May, 1957. (812236.)

31619. Minneapolis-Honeywell Regulator Co.—Electrical control circuits. 9th October, 1957. (812323.)

33545. Mullard, Ltd.—Radio frequency amplifier coupling devices. 28th October, 1957. (812324.)

33818. Dynamit Actiengesellschaft vorm. A. Nobel & Co.—Electric primers for cartridges. 30th October, 1957. (Addition to 805118.) (812257.)

37296. General Motors Corporation.—Method of making paper storage battery separators. 29th November, 1957. (812326.)

37950. Ericsson Telephones, Ltd.—Studs primarily for supporting electrical apparatus. 6th December, 1957. (812259.)

Catalogues and Lists

FANS.—Leaflets describing light duty and industrial type man coolers, and "Breeza" roof units for use where positive controlled roof ventilation is required.—**London Fan & Motor Co., Ltd.**, 27, Brecknock Road, London, N.7.

FIRE ALARMS.—12-page illustrated catalogue describing the "Minerva" system of fire detection.—**Minerva Detector Co., Ltd.**, Richmond, Surrey.

INSTRUMENTS.—Cloth bound 308-page catalogue covering the range of telecommunication measurement equipment and industrial electronic instruments produced by the company.—**Marconi Instruments, Ltd.**, St. Albans, Hertfordshire.

LIGHTING FITTINGS.—Illustrated 24-page catalogue (F.4571) covering display lighting fittings in a wide variety of types.—**General Electric Co., Ltd.**, Magnet House, Kingsway, London, W.C.2.

LUBRICANTS.—Two pamphlets dealing with "Microgel" general purpose grease for high temperature use and the company's silicone oils and greases.—**Shell-Mex & B.P., Ltd.**, Shell-Mex House, Strand, London, W.C.2.

MOTOR CONTROL GEAR.—Illustrated 12-page booklet (1203) dealing with the Crabtree type J-60 automatic control gear.—**J. A. Crabtree & Co., Ltd.**, Lincoln Works, Walsall, Staffs.

PROTECTIVE CLOTHING.—Booklet illustrating and describing the "Plysu" pressure ventilated clothing designed for use by operators in situations where there is a risk of radioactive contamination or where toxic smoke, gas or dust particles present a hazard.—**Plysu Products, Ltd.**, Woburn Sands, Bletchley, Bucks.

RECTIFIERS.—Four publications dealing with selenium, germanium and cooled-cathode rectifier equipment.—**Hackbridge & Hewittic Electric Co., Ltd.**, Walton-on-Thames, Surrey.

RELAYS.—Copy of the company's "Relay Calculator" which has been designed to enable users to ascertain the essential characteristics for any relay they require for a specific purpose.—**Keyswitch Co.**, 2, Irongate Wharf Road, Praed Street, London, W.2.

STEEL.—Illustrated folder describing the latest addition to the company's factory at Warrington producing bright drawn steels.—**William Robertson, Ltd.**, Latchford, Warrington.

SWITCHES.—Catalogue illustrating and describing the range of toggle, slider, push and other types of switches produced by the company.—**D. H. Bonnella & Son, Ltd.**, West Hill, Hoddesdon, Herts.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 27th APRIL

Birmingham.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midland Radio and Measurement Group. "Stereophonic Sound," by K. N. Hawke.

Bristol.—The Grand Hotel, 7.30 p.m. Institute of Marine Engineers, West of England Section. Films on "Engineering at Calder Hall," "Criticality" and "Radio-isotopes in Industry."

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Electronics and Communications Section. "The Field Strengths Required for the Reception of Television in Bands I, III, IV and V," by G. F. Swann.

TUESDAY, 28th APRIL

Edgbaston.—Edgbaston Golf Club, Birmingham Electric Club. 1 p.m. Golf competition, followed by a supper at 6 p.m.

Glasgow.—425, Sauchiehall Street, C.2, 7 p.m. Institution of Heating and Ventilating Engineers, Scottish Branch. Annual general meeting followed by "Applications and Limitations of Packaged Boilers," by A. Wilson.

London.—At the I.E.E., Savoy Place, W.C.2, 6.30 p.m. A.S.E.E. London National Lecture. "Electronic Equipment of Airfields," by E. H. Bruce-Clayton.

London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers, Medical Electronics Group. Two papers on "Electron Microphony," by Professor G. Causey and R. S. Page.

Manson House, Portland Place, W.1, 6 p.m. Society of Instrument Technology, London Meeting. "Measurements in the Photographic Industry," by M. E. F. Howarth and P. B. Watt.

Porthcawl.—Seabank Hotel. Combustion Engineering Association, Western Region. 11 a.m. "The Working of the Clean Air Act," and 2.15 p.m. "Structural Insulation," by P. E. Millington.

WEDNESDAY, 29th APRIL

Chester.—Grosvenor Museum, Grosvenor Street, 7 p.m. Society of Instrument Technology, Chester Section. Annual general meeting followed by film show.

London.—I.E.E. London Graduate and Student Section. 2 p.m. Visit to London Transport's new signalling installation at Rickmansworth and Watford.

Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Guest speaker, P. G. H. Fender.

Northampton.—College of Technology, 7.15 p.m. Northampton and District Electrical Association. Annual general meeting.

Stafford.—County Technical College, 7.15 p.m. I.E.E. North Staffordshire Graduate and Student Section. Annual general meeting and film evening.

WEDNESDAY, 29th APRIL and THURSDAY, 30th APRIL

London.—Savoy Place, W.C.2. Institution of Electrical Engineers. Convention on Thermonuclear Processes. (In conjunction with the British Nuclear Energy Conference.)

THURSDAY, 30th APRIL

Hove.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "Power Factor Correction," by J. W. Fletcher.

London.—St. Ermins Hotel, S.W.1, 10.30 a.m. Combustion Engineering Association. "Economic Purchase of Coal for Small Plants," by Dr. G. Armstrong.

University of London Institute of Education, Malet Street, W.C.1, 7 p.m. Institution of Electronics, London Division. "Measurements in Aviation Physiology," by G. H. Byford.

Sheffield.—Grand Hotel, 7 p.m. Royal Statistical Society, Sheffield Group. Annual general meeting followed by "A General Simulation Programme," by Dr. K. D. Tocker.

FRIDAY, 1st MAY

Bristol.—Grand Hotel, 8 p.m. A.S.E.E. Bristol and West of England Branch. "Plastics in the Electrical Industry," by A. Walters.

Cheltenham.—North Gloucestershire Technical College, 7 p.m. British Institution of Radio Engineers, South Midlands Section. "Transistor Amplifiers," by F. Butler.

Liverpool.—M.A.N.W.E.B., Paradise Street, 7.30 p.m. A.S.E.E. Liverpool and District Branch. "The Use of Light in Combating Crime," by Detective Chief Inspector Weeks.

FRIDAY, 1st MAY to SUNDAY, 3rd MAY

Bournemouth.—I.E.E. Utilisation Section. Section visit.

SATURDAY, 2nd MAY

London.—Victoria Halls, Bloomsbury Halls, Bloomsbury Square, W.C.1, 7 p.m. I.E.E. London Graduate and Student Section. Spring dance.

Sheffield.—E.P.E.A. Sheffield Technical Group. Visit to the Calder Hall nuclear power station.

SATURDAY, 2nd MAY to TUESDAY, 5th MAY

Bournemouth.—Association of Electrical Machinery Trades. Annual Convention.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 8th May:—

BICC. No. 783,639. Class 7. Paper pinion wheels, being parts of machines; and electric vulcanising apparatus.—British Insulated Callender's Cables, Ltd., Norfolk House, Norfolk Street, London, W.C.2.

Transett. No. 753,980. Class 9. Sound recording and sound reproducing apparatus and instruments; television and radio apparatus; gramophones; transformers; condensers; domestic electric utensils; parts and fittings.—Aktiebolaget Transistor, Stockholm, Sweden. Address for service, c/o Carpmaels & Ransford, 24, Southampton Buildings, Chancery Lane, London, W.C.2.

No. 771,260 (design). Class 9. Electric armatures and condensers; and voltage regulators and parts, for use on motor vehicles.—Thomas Bell & Co. (Liverpool), Ltd., 30, Rodney Street, Liverpool, 1.

Ferrantite. No. 770,305. Class 9. Electrical microwave devices.—Ferranti, Ltd., Wickentree Lane, Hollinwood, Lancs.

Nev (design). No. 773,129. Class 9. Cathode ray tubes.—S. J. Rutherford, N. S. Rutherford and M. Turner, trading as Nottingham Electronic Valve Co., 8, Burton Road, Carlton, Nottingham.

Stere-O-Matic. No. 777,191. Class 9. Sound recording, sound reproducing, radio receiving and television receiving instruments and apparatus; electrical instruments and apparatus; parts and fittings, etc.—V-M Corporation, Benton Harbor, Mich., U.S.A. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

Westalert. No. B781,553. Class 9. Periodically-actuated signalling devices for use on rail vehicles; and parts.—Westinghouse Brake & Signal Co., Ltd., 82, York Way, King's Cross, London, N.1.

Permacast. No. 782,756. Class 9. Electrical apparatus and instruments; industrial-chemical apparatus; laboratory apparatus and instruments; and parts and fittings; and electric conduit material and electric conduit fittings.—Permali, Ltd., 125, Bristol Road, Gloucester.

Inframatic. No. 783,719. Class 9. Electrical apparatus for use in detecting infra-red radiation.—Sound Diffusion (Sales), Ltd., Duracraft Works, Portslade, Sussex.

Telesitter. No. 785,255. Class 9. Electrical apparatus for recording and reproducing sound by means of magnetic tape, being goods for incorporation in the circuits of telephone receiving instruments.—K. S. Paul (Printing Machinery), Ltd., Great Western Trading Estate, Park Royal Road, London, N.W.10.

Berleon. No. 782,933. Class 11. Installations for lighting and electric lighting fittings.—H. Strong & Son, Ltd., 20-21, Church Lane, Willesden, N.W.10.

Melric. No. 784,527. Class 11. Installations for heating or steam generating, and parts.—Superheater Co., Ltd., 97, Tottenham Court Road, London, W.1.

Caravel. No. 784,758. Class 11. Heating apparatus, heating installations, and parts.—Simplex Electric Co., Ltd., Broadwell, Oldbury, near Birmingham.

Street Lighting Plans

For the first phase of a scheme for the improvement of street lighting **Bridgnorth** Corporation is recommended to seek loan sanction for £16,140.

The lighting of the Old Kent Road within the borough of **Camberwell** is to be modernised with 140 W sodium discharge lamps at an estimated cost of £5,965.

Carlisle City Council is including in its programme for 1959-60 the first instalment of an £84,000 scheme for changing street lighting from gas to electricity.

Ealing Works and Highways Committee proposes to provide sodium lighting in Western Avenue from Ealing Road, Northolt, to the borough boundary at an approximate cost of £15,365.

East Elloe R.D.C. plans to improve street lighting at a cost of £10,000.

Ilfracombe Corporation has approved a £7,950 street lighting scheme.

Ilkeston Corporation is applying for permission to borrow £18,550 for the conversion of the remaining gas street lighting to electricity.

Application is being made by **Ossett** Council for consent to borrow £5,355 for the conversion of gas to electric lighting in Kingsway, Queen's Drive, Leeds Road, and Pildacre Lane.

Peterborough R.D.C. is to improve the lighting in a number of villages and along the trunk road through Castor, Ailesworth and Eye at an estimated cost of £10,500.

Sunderland Town Council proposes to spend £25,600 on improving the lighting of classified roads and £3,700 on unclassified roads. In addition, more than £37,000 is to be spent converting street lighting in certain areas from gas to electricity.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—State Electricity Commission of Victoria, Melbourne. 6th May. 1,500 66 kV switchgear insulators. (E.S.B. 9582/59. Ten/38623.)*

Electricity Commission of N.S.W., Sydney. 16th June. Two 2,500 kVAr 66 kV 250 c/s filters. (E.S.B. 8842/59. Ten/38526.)*

Canada.—Manitoba Hydro-Electric Board, Winnipeg. 7th May. Monorail hoist for Kelsey generating station. (E.S.B. 8917/59. Ten/38600.)*

Ceylon.—Tender Board, Ministry of Agriculture and Food, Colombo. 28th April. Six 10 kW diesel-electric generating sets. (E.S.B. 9304/59. Ten/38596.)*

Coventry.—Corporation. 7th May. Electric lamps and electrical accessories for the year ending 30th June, 1960. (See this issue.)

France.—Etablissement Central du Matériel du Génie, Versailles. 1st July. Six 250 kVA and two 200 kVA generating sets for scatter stations. (G.D./5564/59. Ten/38642.)*

India.—Director General of Supplies and Disposals, New Delhi. 15th May. Enamelled jumper wire. (E.S.B. 9380/59. Ten/38595.)*

Executive Engineer, Rihand Hydro-Electric Plant Division, Pipri District, Mirzapur. 30th May. Power and multicore cables. (E.S.B. 8648/59. Ten/38463.)*

Iran.—Ministry of Posts, Telegraphs and Telephones. 11th May. Telephone connecting panels and testing apparatus. (E.S.B. 8711/59. Ten/38438.)*

Iraq.—Directorate of Contracts and Purchases, Ministry of Defence, Baghdad. 6th May. Switches, fuses, insulated wire, junction boxes and varnish. (E.S.B. 8373/59. Ten/38419.)*

Korea.—Government Office of Supply, Seoul. 1st May. Automatic telephone exchange equipment. (E.S.B. 9383/59/I.C.A. Ten/38609.)* 8th May. One 750 kVA and three 900 kVA step voltage regulators, one 6,000 kVA transformer, 36,600 watthour meters and 20 time relays. (E.S.B. 8751/59/I.C.A. Ten/38444.)* 13th May. Lead covered telephone exchange cables. (E.S.B. 8236/59/I.C.A. Ten/38408.)* 14th May. Electric power station equipment. (E.S.B. 8752/59/I.C.A. Ten/38468.)* 16th May. One 500 kW broadcast transmitter. (E.S.B. 8758/59. Ten/38427.)*

Neath.—Ministry of Transport and Civil Aviation. 4th May. Class "A" lighting equipment. (See this issue.)

New Zealand.—Auckland Metropolitan Drainage Board. 3rd June. Main switchboard for Orakei pumping station. (E.S.B. 9117/59. Ten/38527.)*

Northallerton.—R.D.C. 12th May. Electrically operated pumping plant in duplicate (Contract No. 2), Appleton Wiske sewerage and sewage disposal scheme. Arnold Brooksbank & Son, Council's consulting engineers, 48, Sunbridge Road, Bradford.

Nuneaton.—Corporation. 16th May. Street lighting equipment. (See this issue.)

Pakistan.—Director General, Department of Supply and Development, Karachi. 7th May. Electric batteries, seismometers, ultraviolet lamps, micro-slides and holders for geological survey work. (E.S.B. 8716/59/I.C.A. Ten/38446.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 29th April. Electrical equipment. (E.S.B. 8929/59. Ten/38475.)*

Romford.—Corporation. 18th May. Street lighting equipment. (See this issue.)

Rothwell.—U.D.C. 8th May. Street lighting equipment. (See this issue.)

South Africa.—Stores Department, South African Railways, Johannesburg. 29th April. Cable. (E.S.B. 9086/59. Ten/38498.)* Two 50 kW, 110 V rectifier sets. (E.S.B. 9087/59. Ten/38495.)* 6th May. Two 11 kV oil circuit-breakers. (E.S.B. 9088/59. Ten/38506.)*

Union Tender Board, Pretoria. 29th April. X-ray apparatus. (E.S.B. 9090/59. Ten/38491.)* 30th April. Radio spares and accessories. (E.S.B. 9058/59. Ten/38508.)*

Tyldesley.—U.D.C. 2nd May. Group "A" lighting columns, lanterns, etc. Engineer and surveyor, Town Hall.

United States.—Public Utility District No. 1 of Chelan County, Washington. 1st May. 115 kV outdoor oil circuit-breakers. (E.S.B. 9612/59. Ten/38626.)*

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aberdeen.—Primary school, Summerfield estate (£128,000); G. Keith, city architect, 11, Broad Street, Castlegate.

Ashford (Middx).—Extensions to County School (£99,000); W. S. Try, Ltd., High Street, Cowley, Uxbridge.

Bath.—Second instalment of Bath Technical College; Underwood & Son, quantity surveyors, 21, Gay Street, Bath.

Birkenhead.—Eleven-storey block of flats, Old Chester Road; borough architect, 3, Conway Street.

Bishop Auckland.—Proposed factory at St. Helen's; Atcost, Ltd., Tunbridge Wells.

Blackpool.—Park School; Grenfell Baines & Hargreaves, architects, 58, Topping Street.

Bristol.—Women's hall of residence, refectory and common room at Clifton Hill House (£225,000); Eustace H. Button, architect, 23, Berkeley Square, Bristol, 1.

Chertsey.—Modernisation of portion of Botleys Park Hospital (£34,350) for South West Metropolitan Regional Hospital Board; R. Mellor, architect, 76, Wimpole Street, London, W.1.

Corsham.—Secondary modern school; T. Holdoway & Sons, Ltd., Station Road, Westbury, Wilts.

Cumberland.—Secondary school, Distington; John Laing & Sons, builders, Dalston Road, Carlisle.

Dewsbury.—Secondary technical school (£225,000); Abbey & Hanson, architects, 11, Cloth Hall Street, Huddersfield.

Doncaster.—Conversion of part of Wood Street furniture warehouse into offices and shops (£65,000); John Peters Co., house furnishers, Doncaster.

Edmonton.—Public offices (10-storey block); H. Backhouse, town clerk, Town Hall, N.9.

Enfield.—Factory; Braham, Patterson & Benham, Ltd., Straysfield Road.

Exeter.—Houses (263), Beacon Lane estate; H. B. Rowe, city architect, Municipal Offices.

Falkirk.—Technical college, Grangemouth Road (£650,000); burgh surveyor.

Fyfield.—Dormitory block for secondary school; Vic Hallam, Ltd., Langley Mill, Nottingham.

Gateshead. — Factory additions for Armstrong Cork Co.; Wimpey & Co., Ltd., contractors, Fenwick Terrace, Newcastle-on-Tyne.

Gillingham (Kent).—Library, Birling Avenue; borough engineer.

Golders Green.—Synagogue, Woodstock Road; D. C. Lichtig, architect, 24, Sparelease Hill, Loughton.

Henley.—Secondary school, Gillott site; county architect, County Hall, Oxford.

Hexham.—Maternity unit at Hexham General Hospital; Newcastle-on-Tyne Hospital Board, Benfield Road, Newcastle-on-Tyne.

Leicester.—Assembly halls and kitchens, Ellesmere Boys' School (£21,068) and Mellor Infants' and Junior Schools (£14,756); city architect.

London.—Office block, 58/64, City Road; Morris de Metz, architect, 29, Gloucester Place, W.1.

St. Katherine's Girls' School, Merton; W. J. Marston & Son, Ltd., 1, Stephendale Road, S.W.6.

Flats (48), St. Mark's Grove, West Brompton; borough engineer, Town Hall, Kensington, W.8.

New Zealand House, Haymarket and Pall Mall; Robert Matthew & Johnson Marshall, architects, 24, Park Square East, N.W.1.

Flats (52), Green Lanes, Stoke Newington; borough engineer, Church Street, N.16.

March.—Dwellings (48), Upwell Road estate; U.D.C. surveyor, March, Cambs.

Middlesbrough.—Flats (65), near West Street; James Miller & Partners, contractors, Wakefield.

Nottingham.—Ten-storey office block, with twelve shops, Friar Lane; Town & City Properties, Ltd., Ormonde House, St. James's Street, S.W.1.

Portsmouth.—Offices, Fratton area; Taylor Woodrow Construction, Ltd., Adrienne Avenue, Southall.

Rugby.—Municipal Offices and Town Hall (£163,920); J. Parnell & Sons, Ltd., builders, Oliver Street.

Somerset.—New wing at the County Hall, Taunton; R. O. Harris, county architect, Park Street, Taunton.

Southend-on-Sea.—Flats (48), Eastwood; borough architect, 30, Alexandra Street.

South Shields.—Additions to Cleadon Park Secondary School (£72,000); T. Clements & Son, Ltd., builders, Dene Joinery Works, Newcastle-on-Tyne.

Development of two shopping sites, Whiteleas estate; J. Reid, borough engineer.

Spalding.—Old people's bungalows, Windsor estate (£31,775); E. E. Cracknell, Ltd., St. Thomas's Road, Spalding, Lincs.

Spennymoor.—Houses (136), Middlestone Moor; Bell & Ridley, Ltd., builders, North Road, Durham.

Stansted.—Secondary school; J. A. Elliott, Ltd., builders, 133, Stansted Road, Bishop's Stortford.

Stockton-on-Tees.—Municipal buildings (£188,000); John Laing & Sons, contractors, Dalston Road, Carlisle.

Wallasey.—Maisonnettes (74), Church Street; J. L. Rawsthorne, Ltd., Woodland Road, Halewood, Liverpool.

Willenhall.—Houses (500); John McLean & Sons, Ltd., Coven, Wolverhampton.